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Beran (F.). **Auftreten und Bekämpfung des Kartoffelkäfers in Österreich im Jahre 1952.** [The Occurrence and Control of the Potato Beetle in Austria in 1952.]—*Pflanzenschutzberichte* **10** pt. 3–4 pp. 52–61, 1 map. Vienna, 1953. (With a Summary in English.)

The potato beetle [*Leptinotarsa decemlineata* (Say)] continued its eastward spread in Austria in 1952 [*cf. R.A.E.*, A **40** 377] and appreciably increased its area of distribution in the provinces of Lower Austria, Burgenland, Styria and, especially, Carinthia. Calcium arsenate and DDT were the insecticides mainly used for control, and defoliation of potato was restricted to a small part of the infested area, with no considerable crop losses.

Wenzl (H.) & Lonsky (H.). **Die räumliche Auswirkung von Infektionszentren der Vergilbungskrankheit der Rübe.** [The Extent of the Area affected by Sources of Infection with Beet Yellows.]—*Pflanzenschutzberichte* **10** pt. 7–8 pp. 97–111, 2 figs., 14 refs. Vienna, 1953. (With a Summary in English.)

Virus yellows of beet was first observed in Austria in 1951. In the following year, a large proportion of the area under sugar-beet was seriously affected, and the disease was also common in mangels. Its spread was doubtless associated with the presence in considerable numbers of *Aphis fabae* Scop., since other Aphids, including *Myzus persicae* (Sulz.), were rare on beet in 1952. Plants grown for seed were found in many cases to serve as sources of infection, and it is concluded from investigations of the distance at which diseased plants were found from them that it is possible for virus yellows to be transmitted to plants a mile or more from the source. The extent of the area of potential infection is probably partly dependent on the effect of wind on the migration of the Aphids.

Beroza (M.). **Alkaloids from *Tripterygium wilfordii* Hook. The Structure of Wilforine, Wilfordine, Wilforgine and Wilfortrine.**—*J. Amer. chem. Soc.* **75** pp. 44–49, 2 graphs, 15 refs. Easton, Pa., 1953. **Alkaloids from *Tripterygium wilfordii* Hook. Isolation and Structure of Wilforzine.**—*T.c.* pp. 2136–2138, 1 graph, 10 refs.

The following are almost entirely the author's summaries of these two papers. All the fragments resulting from the degradation of the ester alkaloids wilforine, wilfordine, wilforgine and wilfortrine have been isolated, and the formula for the sum of the components of each alkaloid is in agreement with the molecular formula calculated from the elementary analysis of each alkaloid [*cf. R.A.E.*, A **40** 204; **41** 65]. It was shown by elementary analysis, paper chromatography and X-ray diffraction patterns that the four alkaloids possess the same polyhydroxy nucleus, $C_{15}H_{26}O_{10}$. This nucleus contains ten hydroxyl groups, but only eight of them are esterified in the intact alkaloid, five with acetic acid, one with either benzoic or 3-furoic acid, and two with a nitrogen-containing dicarboxylic acid. Wilforine and wilforgine have the same dicarboxylic acid, and wilfordine and wilfortrine the hydroxy congener of it. Permanganate oxidation of both dicarboxylic acids gives acetic, oxalic and quinolinic acids. The dicarboxylic acids are 2-substituted nicotinic acid derivatives, and their probable formulae are given.

A small quantity of a new alkaloid, designated wilforzine, was isolated from the roots of *Tripterygium wilfordii* by partition chromatography

employing ultraviolet absorbency ratios. Upon saponification, the alkaloid yields four moles of acetic acid, one of benzoic acid, one of a nitrogen-containing dicarboxylic acid and a polyhydroxy nucleus, which was shown to be identical with that previously isolated from wilforine, wilfordine, wilforgine and wilfortrine. The dicarboxylic acid is identical with the one isolated from wilforine and wilforgine. The formula for the sum of the components of wilforzine is in agreement with the molecular formula $C_{41}H_{47}O_{17}N$, calculated from elementary analyses on the intact alkaloid, which therefore appears to resemble wilforine but to contain one less acetyl group. This conclusion is confirmed by the fact that acetylation of wilforzine produces wilforine, as judged by the X-ray diffraction patterns of their crystals. Evidence is presented that wilforzine is not an artificial product. It was much less toxic than wilforine to larvae of the diamondback moth [*Plutella maculipennis* (Curt.)].

Watters (F. L.) & Smallman (B. N.). **Initial and residual Effectiveness of Spot Fumigants in Elevator Boots.**—*Cereal Chem.* **30** no. 4 pp. 343–348, 1 graph, 3 refs. St. Paul, Minn., 1953.

In comparative experiments on the effectiveness of fumigants of different vapour pressures against insects infesting elevator boots in flour mills [*cf. R.A.E.*, A **38** 274], a proprietary mixture of ethylene dichloride (vapour pressure 80 mm. mercury at 25°C.) and carbon tetrachloride (3 : 1) and another of ethylene dibromide (12 mm.) and chlorinated solvents (3 : 17) were poured into the boot contents at the rate of 12 oz. per boot, and hexachloropropene (0·3 mm.) was applied to a double layer of blotting paper, which was fastened to a strip of tin-foil to prevent loss by leakage, and this was put in a boot that had been emptied of stock, after which the stock was returned; this compound was used at 2 oz. per boot. Treatments were tested by exposing adults of *Tribolium confusum* Duv. in the boots for one day immediately after treatment, and for two days, and in the case of hexachloropropene six days, after various intervals. Mortality was assessed four days after the insects had been removed to fresh flour.

Ethylene dichloride gave complete kill of insects exposed immediately after treatment and 60 per cent. mortality of those introduced a day later, but was ineffective after five days. Ethylene dibromide gave complete mortality of insects exposed immediately or after one day and decreased rapidly in effectiveness after five days. With hexachloropropene, mortality was very low initially, but was nearly 100 per cent. in the two-day exposures for 26 days and 65 per cent. after 49 days. In the subsequent six-day exposures, it was nearly 100 per cent. 62 days after treatment and 10 per cent. 118 days after it. Loaves baked from flour that had been passed repeatedly for up to 20 hours over boot stock treated with hexachloropropene had no abnormal taint or odour.

These results indicate that in incompletely closed spaces, such as elevator boots, fumigants with low vapour pressure and high toxicity are the most effective for local treatment. The sorption of hexachloropropene by treated stock and its gradual release over several weeks was probably the main factor in prolonging its action [*cf.* **38** 275–276]. The great difference in effectiveness between this compound and the others may have been partly due to the different methods of application. Under normal mill conditions, all would probably remain effective for longer. The mills were closed for routine maintenance about once a week, but no change in the effectiveness of hexachloropropene was observed due to the lack of air movement over the stock at these times.

Cranham (J. E.), Higgons (D. J.) & Stevenson (H. A.). ***p*-Chlorbenzyl *p*-Chlorphenyl Sulphide: a new Ovicide for Control of Red Spider.** —*Chem. & Ind.* 1953 pp. 1206–1207, 2 refs. London, 1953.

Investigations in Britain have shown that p-chlorobenzyl p-chlorophenyl sulphide is very toxic to winter and summer eggs and young nymphs of *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi*, auct.) and to eggs and young nymphs of *Tetranychus telarius* (L.). Residues on foliage exert a persistent ovicidal effect and act as stomach poisons on the nymphs even at concentrations at which they are not ovicidal; the adults are apparently not affected, but the compound will reduce an active infestation to negligible proportions in 2–3 weeks because of its persistent toxicity to the immature stages. No insecticidal effect has been observed, and preliminary observations in sprayed orchards revealed active populations of many predacious insects, particularly *Blepharidopterus angulatus* (Fall.), Coccinellids, Syrphids and Anthocorids, and of a predacious mite, *Typhlodromus* sp. The compound is highly lipoid-soluble and penetrates leaves and diffuses across them, but has no systemic effect. It is not injurious to tree and bush fruits, greenhouse crops or ornamental plants, but high dosages showed a selective toxicity to cucurbits. Toxicity to man is very low.

The compound is a white crystalline solid melting at 72°C. and resists reduction and all forms of alkaline and acid hydrolysis. It is very susceptible to oxidation and is oxidised quantitatively by bromine in glacial acetic acid to its corresponding sulphoxide. More vigorous conditions produce the sulphone. Conversion to sulphoxide is very rapid, but that to the sulphone relatively slow. Both oxidation products are as active biologically as the parent sulphide, but do not show the penetrative properties of the latter. The evidence indicates that oxidation can proceed after application to leaf surfaces, probably to the sulphoxide, but the appearance of some sulphone has occasionally been demonstrated. This would apparently account for the persistent effect observed in the field.

In field tests, sprays prepared from dispersible powders or emulsion (miscible-oil) concentrates and containing 0·05 per cent. or less of the sulphide gave outstanding control of *P. pilosus* on apple or pear when applied as late as possible before blossoming, to obtain the maximum leaf surface, but before the main hatch of winter eggs began; this was usually at the green-cluster or pink-bud stage on apple and the white-bud stage on pear. Such treatment gave optimum kill of eggs and nymphs, with good retention of deposits, and resulted under favourable conditions in effective control throughout the season. In the concentrate, the sulphide was effective at bud-burst, but left no persistent deposit on the leaves, and reinfestation occurred during the summer. Two applications at 0·02 per cent. in a dispersible powder or 0·0125 per cent. in an emulsion concentrate at an interval of 3–4 weeks, beginning in mid-June, gave good control of summer eggs. Applications at 0·05 per cent. gave effective control of *T. telarius* in glasshouses or on soft fruits or herbaceous plants out of doors, but the results were best when the sulphide was applied to prevent an initial increase rather than to eradicate an active infestation.

Naudé (C. P.) & Van Zijl (J. P.). **The Toxicity of Pastures after Treatment with Locust Poison. Part I. The Toxicity of treated Pastures. Part II. Arsenic Absorption from the Soil.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 326, 22 pp., 1 fldg. table, 13 refs. Pretoria, 1952.

Prior to 1945, sodium arsenite was the principal insecticide used against locusts in South Africa, and since it was known to be injurious to vegetation

and to render veldt treated with it toxic to livestock, investigations were begun in 1934 on the persistence of these adverse effects. In an experiment described in the first part of this bulletin, a dust and a spray were applied during the rainy season of 1934 at rates of about 12 and 10 lb. sodium arsenite per acre, respectively, and the contents of arsenic as As_2O_3 in the grass and soil were estimated immediately afterwards and at intervals of one, two and six weeks. Both treatments, especially the dust, scorched the grass, although rain fell on the following day. Immediately after treatment, the content of As_2O_3 in dry grass treated with the dust averaged 125 mg. per 100 gm. and that of grass treated with the spray 195 mg., but after three weeks, it had fallen to 1–2 mg., partly because rain had washed off some of the insecticide and partly as a result of the growth of the grass. The arsenic content of grass protected from rain had not reached a safe level ten weeks after treatment. The soil in the two areas contained only 2 and 5 mg. As_2O_3 per 100 gm., respectively, immediately after treatment, and the risk of livestock being poisoned through licking was therefore slight. A similar experiment was performed during the dry season of 1936, when the rates of application were about 8 lb. for the dust and about 7 lb. for the spray per acre. Little growth took place during the period of the experiment, there were no strong winds, and no rain fell for over three months. The content of arsenic in consequence remained high, and three months after application, 18 lb. of grass treated with the dust or 4 lb. of that treated with the spray would have provided a lethal dose for an animal that ingested it. There was an immediate decrease in the arsenic content after the first shower, which amounted to only 0·5 inch. The arsenic content of the soil was again highest (8 and 7·6 mg. per 100 gm.) immediately after treatment, but was still not hazardous.

In the first of the experiments described in the second part, Sudan grass [*Sorghum sudanense*] growing in a red clay-loam soil in pots was treated with solutions of sodium arsenite at rates equivalent to about 10, 40 and 100 lb. poison per acre and the arsenic content of the aerial parts was estimated at fortnightly intervals over a period of 14 weeks. In all cases, the arsenic content was highest during the first fortnight and then rapidly decreased; that of grass treated at 10 lb. per acre, which is the rate recommended for locust control, was only 1·92 mg. As_2O_3 per 100 gm. after two and 1·12 mg. after four weeks, and was not high enough to be toxic to livestock. These results were confirmed by a similar test in 1939, in which clover in a red clay soil and rooigras (*Themeda triandra*) in light sandy soil were treated with seven arsenical compounds at rates equivalent to about 17 and 86 lb. As_2O_3 per acre, respectively. It was further found that clover absorbed more arsenic than rooigras, that the roots contained more arsenic than the aerial parts, and that the arsenic content of the plants increased with the dosage applied. It is possible that applications as high as 200 lb. sodium arsenite per acre would render pastures toxic to livestock.

Fickewirth (E.). **Beitrag zur Bekämpfung des Maiszünslers** *Pyrausta nubilalis* **Hb.** [A Contribution to the Control of *P. nubilalis*.]—*Anz. Schädlingsk.* **25** pt. 6 pp. 84–86, 10 refs. Berlin, 1952.

Pyrausta nubilalis (Hb.) is injurious to maize in south-western Germany, where it has one generation a year, and since the methods of mechanical and cultural control recommended against it are of doubtful value, tests of insecticides were begun in 1950. In that year, materials reputed to have a systemic effect were tested in September, when the larvae were in the lower third of the plants, but spraying with a parathion emulsion (E 605

forte), dusting with methyl-parathion (E 605 Staub) or Potasan [O,O-diethyl O-7-hydroxy-4-methyl-coumaryl thiophosphate] and spraying or watering with Systox [O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate] were useless. In 1951, proprietary dusts and sprays of DDT and BHC alone or in combination, the parathion emulsion spray and the methyl-parathion dust all killed larvae feeding on the outside of the plants, but had no effect on those that had entered the stalks. Emulsion sprays adhered better than suspensions, and it is recommended that the plants should be sprayed with a combination of DDT and BHC at intervals of 10–14 days for 3–4 weeks from the beginning of hatching, applications to be repeated after rain.

Stübner (K.). **Fluoreszenzmikroskopischer Nachweis von DDT und seinen Mitteln.** [Fluorescent microscopic Detection of DDT and Preparations containing it.]—*Anz. Schädlingsk.* **25** pt. 7 pp. 97–100, 7 figs., 3 refs. Berlin, 1952.

The author figures and explains the use of an apparatus for projecting long-wave ultra-violet light or short-wave blue light on to the reflector of a microscope. DDT particles are fluorescent in this light and, when viewed microscopically through suitable filters, are clearly distinguishable from inert spray residues or dust carriers. The effect can be increased by the use of fluorescent stains. This technique can be used for the qualitative and to some extent the quantitative determination of DDT, for measuring the particle size and distribution of DDT in commercial insecticides, and for demonstrating its presence on plant surfaces and on or possibly in insects. When it was used to study the relation between DDT and inert carriers, it appeared from observations on the intensity of the fluorescence that the insecticide adheres to the surface of particles of slate dust but is absorbed by particles of kaolin and talc.

Vogel (W.). **Die Verwendung von Parathion zur Bekämpfung der Kirschenfliege** (*Rhagoletis cerasi* **L.**). [The Use of Parathion for the Control of *R. cerasi*.]—*Anz. Schädlingsk.* **25** pt. 7 pp. 100–102, 1 ref. Berlin, 1952.

DDT has been used for several years for the control of *Rhagoletis cerasi* (L.) on cherry in Switzerland, the trees being sprayed to kill the adults before oviposition begins, but as the treatment has to be applied over a large area to give good results, a search was made in 1949–51 for measures that could be taken by individual growers. Various parathion sprays proved unsatisfactory when applied in spring to the soil or the grass beneath the trees against the emerging or newly emerged adults, and larvae pupated normally in sand moistened with a dilute spray fluid. Spray deposits on leaves and fruits quickly lost their toxicity to adults, and infestation of cherries was as heavy on trees sprayed with parathion before oviposition began as on untreated trees. Better results were given by spraying against the eggs and young larvae. One tree was sprayed seven days after oviposition began with a mixture containing 0·03 per cent. parathion and 0·1 per cent. DDT, some of the branches being shielded from the spray. Several treated and untreated branches were then covered with gauze to protect them from further infestation, and a month later the percentages of fruits infested by larvae on these were 0 and 96, respectively, but the treatment did not prevent further oviposition on the uncaged branches. In a further test, groups of trees were sprayed with 0·1 per cent. DDT

alone or with 0·02 per cent. parathion ten days after the beginning of oviposition, when averages of 3–8 per cent. of the fruits contained eggs. A week later, the percentages of cherries containing larvae were 6·6 and 0·8, respectively, for these two treatments, as compared with 49 in the controls. Finally, a single tree on which 40–60 per cent. of the fruits contained eggs was sprayed with the mixture of DDT and parathion, some of the branches being protected from the spray and a few of these being then sprayed with DDT alone. A month later, the percentages of cherries infested by larvae were 52, 36 and 2, respectively, for no treatment, DDT alone and the mixture of DDT and parathion.

Berichtigung. [Correction.]—*Anz. Schädlingsk.* **25** pt. 7 p. 112. Berlin, 1952.

It is pointed out in this correction to a paper by D. Godan already noticed [*R.A.E.*, A **41** 431] that the percentage of E 605 forte [an emulsion concentrate containing 50 per cent. parathion] finally recommended for sprays against *Ceuthorrhynchus assimilis* (Payk.) and *Dasyneura brassicae* (Winn.) on rape in Germany should have been 0·5 and not 1·5 as stated by the author.

Fedotov (D. M.) & Bocharova (O. M.). **The Effect of the Preparation DDT on the Noxious Little Tortoise.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **75** no. 4 pp. 587–590, 2 figs., 10 refs. Moscow, 1950.

Laboratory observations on the effects of DDT on *Eurygaster integriceps* Put. were carried out in the Province of Krasnodar (North Caucasus) in May–July 1950. Complete mortality of the overwintered adults was given by a 5·5 per cent. DDT dust, both when this was applied with a brush to various parts of the body and when the bugs were dusted in cages at the rate of 45 lb. per acre, males dying sooner than females. The dust was also highly toxic to the older nymphs, giving complete mortality of those in the fourth and fifth instars, though these have been reported as somewhat resistant [*R.A.E.*, A **40** 95]. Young adults became more resistant with age, all those that had emerged 2–3 days previously and were still feeding being killed, whereas those that had completed their early feeding and had a developed fat-body and reserves of food in the intestine were not affected, though they invariably succumbed in tests by other workers when a solution of DDT in kerosene was applied topically to the back.

Dissection of overwintered females dusted with DDT showed that the poison caused injury to various internal organs, including the ovaries and the mid-gut. Damage to the former reduced oviposition, and injury to the gut resulted in death.

Fedotov (D. M.) & Makhotin (A. A.). **The Effectiveness of dusting Fields of Autumn-sown Wheat with the Preparation DDT against the Noxious Little Tortoise.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **75** no. 6 pp. 887–889, 5 refs. Moscow, 1950.

Aeroplanes were used to apply a dust of 5·5 per cent. DDT for the control of *Eurygaster integriceps* Put. in fields of wheat in the Province of Krasnodar (North Caucasus) in 1950. The dust was applied at 63 and 31·5 lb. per acre against the overwintered adults on 26th–28th April. At the higher rate, it gave maximum and average mortalities of 69 and 56·7

per cent. in 7–10 days, based on counts of dead bugs on sample plots, and more than halved the numbers of living bugs per unit area. At the lower rate, the corresponding mortality percentages were 48 and 35·5, and the population was halved. Bugs were seen flying from the treated fields, and examples showing symptoms of poisoning were found in untreated ones. Mortality reached its height in 3–4 days, and the dust appeared to have lost its toxicity in about a week. Although mortality was not high, the reproductive ability of the survivors was reduced [*cf.* preceding abstract], and when the numbers of nymphs present a month after treatment were compared with the numbers of adults 20 days after it, it was found that the numbers of nymphs per adult were 12·66 in the treated fields and 110·83 in untreated ones.

The dust was applied to the same fields against the nymphs at 36 lb. per acre on 25th May and reduced the population by 92·7 per cent. in eight days. There was less than one survivor per sq. yard after 17 days. The same treatment in previously undusted fields also gave very high mortality of the nymphs, mostly in the second or third instar, and the survivors averaged little more than one per sq. yard after 18 days. Adults of the new generation proved resistant, treatment at 36 lb. per acre giving only 1·8 per cent. mortality [*cf.* preceding abstract]. The effective treatments were reflected in greatly increased yields.

Sorokin (S. V.). **The Soil of Fields as a Biotope of Grain Mites (Acarina, Tyroglyphoidea).** [*In Russian.*]—*Ent. Obozr.* **31** no. 3–4 pp. 411–415, 8 refs. Moscow, 1951.

Investigations on the occurrence of grain mites in the soil of cultivated fields [*cf. R.A.E.*, A **23** 577; **25** 570] were carried out during the summers of 1938 and 1939 in the Province of Kirov and in 1941 in the Province of Vologda. Though these two districts are about 400 miles apart, their climatic conditions are similar. Since the examination of soil samples by the usual method did not reveal any mites, small muslin bags containing a sterilised bait mixture of ground grain and finely chopped hay and straw were sunk into the ground at depths of 4–16 ins. and examined fortnightly. The investigations were made in fields under flax, clover and various cereals, and mites were found in all of them. They were most numerous near the soil surface in most of the fields and in the second half of the summer. In all, eight species were found, and their frequency in the different fields is shown in a table. The commonest were *Acotyledon sokolovi* Zkhv., *Rhizoglyphus echinopus* (Fum. & Rob.) and *Tyroglyphus farinae* (Deg.), all of which are pests of stored products.

Avetyan (A. S.). **Injury to Grape Vine in Armenia by the False Bark-beetle *Sinoxylon perforans* Schrank (Coleoptera, Bostrychidae).** [*In Russian.*]—*Ent. Obozr.* **31** no. 3–4 pp. 422–427, 2 figs., 8 refs. Moscow, 1951.

In May 1949, an outbreak of *Sinoxylon perforans* (Schr.) occurred on grape vines in the Republic of Armenia, where this Bostrychid had not previously been recorded, though it was known to occur in other southern parts of the Soviet Union. The adults and larvae are described. Observations in May showed that only vines that were diseased, weakened by frost or heavily infested by *Phylloxera* were attacked. Stems and shoots about 1½ ins. in diameter were infested, the adults and larvae boring under the bark. No pupae were found, but dead adults sometimes occurred at

the end of the larval galleries. There were two generations a year, the larvae hibernating and giving rise to adults in May. Adults of the first generation emerged in August. Since the beetle is a secondary pest, infestation is best prevented by maintaining the vines in a healthy condition. Very brief notes are appended on the appearance and habits of other Bostrychids that have been recorded from grape vine in Armenia; all are apparently secondary pests of little consequence.

PARFENT'EV (V. Ya.). **Scolytids and Cerambycids infesting** *Picea schrenkiana*. [*In Russian.*]—*Ent. Obozr.* **31** no. 3–4 pp. 428–434, 7 figs. Moscow, 1951.

Notes are given on the bionomics of eight species of Scolytids and three Cerambycids that were observed attacking *Picea schrenkiana* in plantations at altitudes of about 6,230–10,170 ft. in the mountains of the Kazakh and Kirgiz Republics. Surveys in 1930–32 showed that infestation was widespread and had caused severe damage, many trees having been killed by the beetles or rendered liable to attack by other pests. The most injurious were the Scolytids, *Pityophthorus kirgisicus* Pyatn., *Ips* (*Pityogenes*) *spessivtsevi* (Lebedev), and *I. hauseri* Rttr., and the Cerambycids, *Tetropium staudingeri* Pic and *Dokhtouroffia nebulosa* (Gebl.).

RUBTSOV (I. A.). *Aphytis chrysomphali* **Mercet—a Parasite of the Brown Scale.** [*In Russian.*]—*Ent. Obozr.* **31** no. 3–4 pp. 435–449, 4 figs., 20 refs. Moscow, 1951.

Chrysomphalus dictyospermi (Morg.), the world distribution of which is briefly reviewed, occurs in various districts in the south-west of the Soviet Union, including the Black Sea coast of the Caucasus, where it has long been common near large towns such as Batum, Sukhum and Sochi. The heaviest infestations in the Caucasus occur on *Citrus* in greenhouses and in shady sites outdoors. The bionomics of the Coccid are reviewed from the literature, and it is pointed out that it has few parasites in the Soviet Union. The most important is *Aphytis chrysomphali* (Merc.), which is present in the main centres in the Caucasus. The egg, third-instar larva and adult female of this Aphelinid are described, and its bionomics and alternative hosts are reviewed. Observations showed that it is abundant at Batum and Sochi in late summer and autumn. At Sochi in 1947–48, it parasitised a high percentage of the scales on tall *Citrus* trees, but considerably fewer on shrubs such as tea. It is desirable that a survey for the presence of *C. dictyospermi* should be made in all plantations of *Citrus* and other subtropical plants in the area, and *A. chrysomphali* introduced wherever it does not already occur. It would be best liberated in August–September, when both it and the scale are abundant.

SHAPOSHNIKOV (G. Kh.). **A new Genus and Species of Aphid (Aphididae) from Apple.** [*In Russian.*]—*Ent. Obozr.* **31** no. 3–4 pp. 517–520, 2 figs. Moscow, 1951.

Descriptions are given of the fundatrix, winged migrant, sexupara and sexuales of *Malaphis magna*, gen. et sp. n., from the leaves of apple near two places in the Carpathian mountains, in the Ukraine. The new genus, the characters of which are given, is closely allied to *Anuraphis*. The Aphid was observed only on wild apple in spring, feeding on the lower surfaces of the leaves and causing them to roll, but was numerous on cultivated

apple in autumn, though it caused no injury to it; its summer food-plant is unknown. Fundatrices were observed in May 1951 and migrants on 3rd June. Migration occurred at the end of May or the beginning of June and was complete in the second generation. Sexuparae occurred at the beginning of October in 1949, and mass pairing of the sexuales was observed from 19th to 26th October. The Aphid has also been taken on apple in Georgia and North Caucasus.

Nikol'skaya (M. N.). **A new Species of** *Gonatocerus* **(Hymenoptera, Mymaridae) from the Eggs of the Jassid** *Cicadella viridis* **L.** [*In Russian.*]—*Ent. Obozr.* **31** no. 3–4 pp. 575–576, 1 fig., 1 ref. Moscow, 1951.

A description is given of the adults of both sexes of the Mymarid, *Gonatocerus cicadellae*, sp. n., reared in 1947–49 from the eggs of *Tettigella* (*Cicadella*) *viridis* (L.), in the Kirgiz Republic.

Bogush (P. P.). **Use of Light-traps as a Method of Studying the Dynamics of the Abundance of Insects.** [*In Russian.*]—*Ent. Obozr.* **31** no. 3–4 pp. 609–628, 10 figs., 5 refs. Moscow, 1951.

This paper is based on the literature [*cf. R.A.E.*, A **16** 151; **23** 669; **25** 72] and further work by the author in Soviet Central Asia, and comprises a detailed discussion of the ways in which light-traps can be used in the study of various aspects of the abundance of insects, illustrated by examples drawn from practice. The work is designed to facilitate the forecasting of outbreaks.

Clark (L. R.) & Clark (N.). **A Study of the Effect of** *Chrysomela hyperici* **Forst. on St. John's Wort in the Mannus Valley, N.S.W.**—*Aust. J. agric. Res.* **3** no. 1 pp. 29–59, 3 figs., 10 refs. Melbourne, 1952.

Chrysomela hyperici Forst. has given promising control of the noxious weed, *Hypericum perforatum*, in Victoria [*cf. R.A.E.*, A **39** 38, etc.], but has proved less successful in the Mannus Valley of New South Wales, where conditions are not so favourable for the beetle. Investigations were made in 1948–49 on its effect on the weed in one area in the valley where a colony was released in November 1944, and a detailed account is given of the work, with the results of local studies on the bionomics of both Chrysomelid and plant. The area consisted of derelict farmland and was covered almost entirely by *Hypericum* in 1948; an area of 1·75 acres had been defoliated in 1947. It was found that the adults emerge during October and the first half of November and aestivate during December–April. Eggs were laid during April–July, hatching began in late June, and the larvae were most abundant in August or September. Most entered the soil in late September and pupated in October. The winter was therefore passed in the larval stage, and not in the egg stage as in England [*cf.* **20** 612]. Dispersal by flight was very limited. Both adults and larvae tended to congregate at the perimeter of defoliated zones, and mass movements occurred only when the food-supply was exhausted.

Populations decreased considerably during the study period, owing principally to high mortality before oviposition was completed in 1948, but work in progress elsewhere indicates that contributory environmental factors probably include low winter temperatures, which destroy some of the

larvae, local exhaustion of food-supplies, which militates particularly against the young larvae, and heavy rain. Natural enemies were very scarce.

During the six years following its liberation in the area, *C. hyperici* had increased and spread to a limited extent in the more favourable parts, but in December 1950, the area defoliated by it occupied less than one acre. It is therefore concluded that conditions were either unfavourable or barely tolerable for the beetle. Though it caused great destruction of the weed in places, this was quickly followed by regeneration by means of seeds or suckers, and as a result of this and the tendency of the Chrysomelid to move along definite fronts, successive waves of insects passed to and fro over a small area round the liberation site followed by waves of regeneration of the plant. Very young and large old crowns of *Hypericum* were readily destroyed by the combined feeding of larvae and adults [*cf.* **39** 38], but mortality among crowns of medium size was low. Unless a high proportion of crowns was destroyed, the vacant space was quickly reoccupied by suckers produced by the surviving plants, and under some conditions the production of suckers was stimulated by defoliation [**39** 38], resulting in the development of a stand with a higher crown density than the original one. Even when nearly all the crowns were killed, regeneration from seed was so rapid as to permit the development of a fairly dense stand within two years. The importance of the Chrysomelid in reducing seed production is thought to have been overestimated, since enormous quantities of seeds are produced annually and many remain viable for years. Unless very high proportions of the plants over an extensive area are prevented from flowering until nearly all the seeds produced prior to defoliation are dead, the suppression of flowering stems is of little benefit. In view of the high mortality and poor powers of dispersal of *C. hyperici*, it seems likely that the weed will continue to regenerate in the area almost as rapidly as it is destroyed. Its ability to remain predominant despite heavy insect damage is due in part to the absence or destruction by rabbits and kangaroos of effective plant competitors [*cf.* **21** 625]. These animals also assist the regeneration of *Hypericum* by scratching the soil and so providing favourable conditions for seed germination.

Sanford (G. B.). **Phloem Necrosis of Potato Tubers associated with Infestation of Vines by** *Paratrioza cockerelli* **Sulc.**—*Sci. Agric.* **32** no. 8 pp. 433–439, 2 pls., 12 refs. Ottawa, 1952.

Psyllid yellows [*cf. R.A.E.*, A **21** 454] was first reported on potato in Canada at Medicine Hat, Alberta in 1932 [**22** 690], when tomatos in greenhouses in the vicinity were heavily infested by *Paratrioza cockerelli* (Šulc). It recurred in subsequent years in the same general area, and serious outbreaks of what appeared to be the same affection, but with general phloem necrosis of the tubers as an additional symptom, occurred in 1938 and 1939 near places where there were greenhouses infested by the Psyllid. Damage was light in 1940, following fumigation of the greenhouses, but it persisted at Lethbridge until 1943, when the cold winter killed the Psyllids in the greenhouse there.

The symptoms, which are described in detail, appeared first on the apical shoots and developed on healthy plants about ten days after they had become infested by *P. cockerelli* under field conditions during July–August. Plants grown in the field under canvas or in greenhouses did not develop phloem necrosis, and the other symptoms were modified. The relation between the disease and feeding by *P. cockerelli* was demonstrated during 1939–41, when plants from a healthy stock of tubers raised in northern Alberta, where *P. cockerelli* is not known to occur, developed symptoms

when grown in full sunlight and exposed to infestation by the Psyllid in southern Alberta, but remained healthy in full sunlight in north-central Alberta. Affected tubers, even if not necrotic, produced weak sprouts or none at all; in general, loss of vigour was directly proportional to the degree of necrosis. The progeny of infected tubers grown in areas free from *P. cockerelli* recovered completely in two seasons, and in view of this rapid recovery, the absence of infection with leaf-roll in the season following general attack, and the symptoms caused, which differed from those of the known potato viruses, it is concluded that the causal agent was a toxic substance secreted by the insect and injected into the plant during feeding, with systemic effects. Some inconclusive evidence was obtained that it can be transferred from affected to healthy plants by grafting. The appearance of a toxic agent of such severity might have resulted from a genetic mutation in the local population of the Psyllid.

Anderson (R. W.), Blakely (R. M.) & MacGregor (H. I.). **The Toxicity of Aldrin for growing Turkeys.**—*Sci. Agric.* **32** no. 11 pp. 586–591, 5 refs. Ottawa, 1952.

In view of the widespread use of aldrin for the control of grasshoppers in Canada during 1950–51, information on its effect on poultry [*cf. R.A.E.*, A **40** 177] was desired, and the following is largely the authors' summary of investigations on its chronic toxicity to turkeys. In three experiments, technical aldrin was added to the diets of growing turkeys in pens at rates of 1·5–1,000 parts per million. Rates of 100 p.p.m. or more rendered the feed unpalatable, and rates of 25 p.p.m. or more caused death within ten days. The average survival periods were 4·2 and 8·2 days for birds that received 1,000 and 25 p.p.m., respectively. A rate of 12·5 p.p.m. killed three out of 20 birds over a feeding period of 42 days. Technical aldrin caused a significant depression in the growth rate of males at 3 p.p.m. and in that of both sexes at higher rates. Birds that had received 12·5 p.p.m. in their diet for a period of 42 days suffered extremely high mortality when returned to an aldrin-free diet on range under adverse weather conditions, whereas the control birds and those that had received lower rates were not affected. The symptoms observed and the findings of post-mortem examinations are reviewed. The latter indicated interference with the function of the brain and the nervous system.

Jacobson (L. A.), McDonald (H.), Lindsay (I. S.) & Blakeley (P. E.). **Preliminary Investigations in chemical Control of the Pale Western Cutworm, *Agrotis orthogonia* Morr. (Lepidoptera: Phalaenidae).**—*Sci. Agric.* **32** no. 11 pp. 592–596, 7 refs. Ottawa, 1952.

Since BHC and chlordane were shown in preliminary laboratory experiments to be effective as contact insecticides against larvae of *Agrotis orthogonia* Morr. [*R.A.E.*, A **38** 2], the relative value of these and four other materials applied in emulsion sprays by a low-volume sprayer was investigated in the field in Saskatchewan in 1950–51. The sprays were applied to the surface of the soil and the vegetation in plots in infested wheat fields about the middle of June, when the larvae were mostly in the fifth and sixth instars and still causing damage. Larval populations averaged 80 per 50 samples of 1 sq. ft. in both years, and mortality was calculated by Abbott's formula [**13** 331]. Counts 14 days after treatment showed that chlordane at 24 oz. per acre gave the best results (82 per cent. mortality) and its use at this rate is considered practicable. Dieldrin

was almost as effective (81 per cent. mortality) at only 8 oz. per acre, but was not at that time licensed for use in Canada. Aldrin at 8 oz. gave 70 per cent. mortality in 1950 but only 6 per cent. in 1951, and toxaphene at 32 oz. and γ BHC at 2 and 4 oz. gave fair control. Heptachlor was inferior. Living larvae collected on the treated plots 5–14 days after spraying were kept in the laboratory to determine the persistence of the toxic effects. All the materials showed some persistent toxicity, but chlordane showed most, and all the larvae collected 14 days after treatment with it at 24 oz. per acre eventually died. Chlordane, dieldrin and aldrin were all less and toxaphene more effective in 1951, when the weather was cool and showery, than in 1950, when it was warm and dry [*cf.* **41** 362, etc.]. In large-scale tests in which chlordane and toxaphene were applied at 16 and 24 oz. per acre, respectively, to infested fields, both reduced populations to a point at which they caused no further damage, and no damage occurred in a field that was reseeded immediately after spraying with chlordane.

Burchfield (H. P.), Hilchey (J. D.) & Storrs (E. E.). **An objective Method for Insecticide Bioassay based on Photomigration of Mosquito Larvae.**—*Contr. Boyce Thompson Inst.* **17** no. 1 pp. 57–86, 7 figs., 12 refs. Yonkers, N.Y., 1952.

Existing methods of using larvae of *Aëdes aegypti* (L.) for the bioassay of parathion and other synthetic insecticides [*cf. R.A.E.*, A **39** 6; **40** 154] are sometimes inadequate because too few larvae per dose are tested to provide a representative sample of the population and because the estimation of mortality is laborious when large groups are used and often difficult. In this paper, the authors discuss the difficulties inherent in estimating mortality of the larvae by direct observation, describe the equipment and technique used in a rapid procedure for determining the proportion moribund, based on the tendency of the larvae to move away from a strong light, and give the preliminary results of attempts to recover insecticidal residues from raw and processed foods for bioassay purposes and a detailed account of factors affecting the accuracy of test results.

The larvae are confined at one end of a transparent trough containing an acetone suspension of the test chemical, by means of a porous barrier one inch from the end. When this end is illuminated by a 500-watt lamp and the barrier removed, unaffected larvae move to the other end of the trough, whereas those that are dead or moribund remain. After one minute, a second barrier is dropped three inches from the light end of the trough, and the larvae behind it are regarded as having been inactivated by the toxicant.

The technique was used successfully to determine the paralytic action of several insecticides by maintaining larvae in a series of dilutions at 29°C. [84·2°F.] for 24 hours and then testing, and to measure the time required to inactivate half the population, by repeating a test with one sample of insecticide and the surviving insects until 80–90 per cent. were inactivated, and recording total time elapsed and cumulative percentage of larvae moribund at each repetition. It is semi-specific for liposoluble neural poisons and narcotics, and can be used in the secondary screening of new insecticides. Knockdown and other toxicological characteristics can be compared with a standard on a quantitative basis.

In the tests on the application of the method to the bioassay of residues in foods, pentane and hexane were more satisfactory solvents for extracting DDT than benzene, which has been used for the purpose, since they remove less plant material and can be evaporated at lower temperatures.

Flanders (S. E.). **Predatism by the adult Hymenopterous Parasite and its Role in Biological Control.**—*J. econ. Ent.* **46** no. 4 pp. 541–544, 18 refs. Menasha, Wis., 1953.

Some parasitic Hymenoptera, notably *Metaphycus helvolus* (Comp.), kill their hosts not only by developing in them as larvae but also by puncturing them with the ovipositor and feeding on the body fluids as adults [*cf. R.A.E.*, A **32** 192; **41** 259], and such feeding is sometimes necessary for egg maturation. In this discussion of the economic importance of the habit, the author points out that its value depends on the relative abundance of host and parasite. It tends to increase the variation in population of the two species and the rate at which the parasite reduces high host densities. However, host-feeding species require a higher minimum host population for development than others, since the initial host-feeding of the female may so deplete a small population that few individuals remain for later reproduction of the parasite, and they are therefore probably less effective than others against pests that cause economic damage at relatively low densities. It appears, therefore, that host-feeding parasites are less effective than others for the continued suppression of pest populations, but useful for periodic mass releases.

Thurston (R.). **The Effects of some Soil Characteristics on DDT Phytotoxicity.**—*J. econ. Ent.* **46** no. 4 pp. 545–550, 8 refs. Menasha, Wis., 1953.

The following is substantially the author's summary of investigations on the possible phytotoxic effects of accumulated DDT residues in soil. In field tests in New Jersey in which open cylinders were sunk into the ground, beans and rye were severely stunted by both purified and technical DDT, incorporated at the rate of 200 lb. per acre, in six mineral soils of varying texture, but much less so in a peat soil. Although purified DDT was less phytotoxic than technical DDT in some cases, the differences were slight, and no relation between the texture of the mineral soils and the phytotoxicity of DDT was apparent.

In greenhouse experiments, wettable DDT added to nutrient solutions consistently reduced the root growth of bean seedlings by the end of ten days. Purified DDT almost completely stopped root growth at the rate of ten parts per million and curtailed the development of lateral rootlets and caused the production of many thick, unbranched roots at lower rates. Analysis of bean foliage showed that there was about half as much soluble phosphorus in plants treated with purified DDT as in untreated ones. The addition of two strong-base anion exchange resins to nutrient solutions containing DDT reduced its phytotoxicity, whereas a weak-base anion exchange resin had much less effect, and a cation exchange resin was ineffective. Activated wood and bone carbons were very effective in adsorbing DDT in the nutrient solutions and preventing phytotoxicity.

Frazier (N. W.). **A Survey of the Mediterranean Region for the Beet Leafhopper.**—*J. econ. Ent.* **46** no. 4 pp. 551–554, 1 map, 10 refs. Menasha, Wis., 1953.

The following is substantially the author's summary. As an initial step in investigations on the possibility of the biological control of *Circulifer tenellus* (Baker) on beet in California, a survey for this and allied species of *Circulifer* was carried out in 1951 in the Mediterranean basin. Nearly 30,000 Jassids were collected, of which about 7,500 were *Circulifer.*

C. tenellus was taken in Algeria, Tunisia, Tripolitania (Libya), Egypt and Spain, and the last of these countries appeared to be the most favourable in which to search for parasites and predators of it.

Reynolds (H. T.), Anderson (L. D.) & Swift (J. E.). **Tests with two Systemic Insecticides on Vegetable and Field Crops in southern California.**—*J. econ. Ent.* **46** no. 4 pp. 555–560, 3 refs. Menasha, Wis., 1953.

The following is based on the authors' summary of this account of investigations carried out in southern California in 1951 on the relative effectiveness of schradan and Systox (a product containing a mixture of O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate and O,O-diethyl S-2-(ethylmercapto)ethyl thiophosphate [*cf. R.A.E.*, A **41** 359]) for the control of insects and mites attacking vegetable and field crops.

Both materials gave excellent control of *Brevicoryne brassicae* (L.) on cabbage. Plants grown from seeds soaked in solutions of the insecticides remained free from Aphids for some time, but became infested before they were ready for transplanting from the boxes, and watering young plants in the boxes with solutions a few days before transplanting gave very good control for two months. Solutions applied to the base of newly set plants gave excellent control until harvest. Sprays of 1·4–3 lb. schradan or 0·5–2 lb. Systox per acre gave excellent control for 50 days and 32–79 and 51–85 per cent. reduction of population, respectively, as compared with no treatment, after 76 days.

Sprays of the two materials also gave very good control of *Macrosiphum pisum* (Harris) (*pisi* (Kalt.)) and *Tetranychus atlanticus* McG. on lucerne. Control of the Aphid appeared to be more effective on nearly mature plants than on shorter, rapidly growing ones, and Systox at 0·5 and 1 lb. per acre was outstanding against the mite and superior to 2 lb. schradan per acre. Schradan at 2 lb. and Systox at 1·4 lb. per acre gave fair to good control of *Anuraphis tulipae* (Boy.) on carrot, whereas Systox at 0·5 lb. per acre gave only fair results. Control of *Myzus persicae* (Sulz.) on sugar beet was excellent with 0·55–1·4 lb. Systox per acre, but poor with 1·1–3·5 lb. schradan, probably because the initial kill was high with the former and low with the latter. These last tests indicated that, in crops with tap roots, large amounts of systemic materials applied in sprays may be translocated and held in the roots.

Neither schradan nor Systox gave good control of *Thrips tabaci* Lind. on onions, though Systox caused a fair initial reduction in population, and 1–2 lb. Systox and 2 lb. schradan per acre caused little or no reduction in populations of *Tarsonemus pallidus* Banks on strawberry. Schradan sprays applied to the point of run-off did not reduce the numbers of larvae of *Trialeurodes abutilonea* (Hald.) on cotton.

Pierce (W. C.). **Studies of Mites and their Control on Pecan in Louisiana.**—*J. econ. Ent.* **46** no. 4 pp. 561–565, 1 ref. Menasha, Wis., 1953.

Observations were made in 1946–52 on the habits of five species of mites that attack pecan in Louisiana, the injury they cause and the effect of different treatments against the more important. *Tetranychus hicoriae* McG. occurs on both surfaces of the leaflets, but appears to feed and reproduce mainly on the under side, heavy infestations causing premature leaf fall. *Brevipalpus* sp. and *B. sayedi* Baker also occur on the under side of the leaflet, near the veins, causing these and the adjacent tissue to turn brown, and attack the husks of the nuts. *Paratetranychus viridis*

(Banks) occurs on both leaf surfaces, but appears to feed and reproduce principally on the upper one, and *Aceria* (*Eriophyes*) *caryae* (Kiefer) feeds on the margin of the leaflet, causing it to form a gall-like roll, in which the mites can be found in large numbers. *T. hicoriae* was the most important, and severe infestations occurred throughout northern Louisiana, some, but not all, following the application of sprays of DDT and other insecticides. Some of the heavily infested orchards also contained large numbers of the Aphid, *Melanocallis caryaefoliae* (Davis), and of the two species of *Brevipalpus*, which appeared to weaken the leaves and render them susceptible to damage by *T. hicoriae*. Heavy infestation by *A. caryae* and *P. viridis* was less frequent and did not cause serious defoliation. *T. hicoriae* and *Brevipalpus* overwintered as full-grown females in protected sites in the bark and became active soon after tree growth began in spring. Eggs and other stages of *T. hicoriae* were observed on the foliage from April until late October, and though severe infestations were observed from June onwards, most of the damage occurred in July–September. Heavy defoliation in August and early September usually resulted in poor flowering in the following spring.

In preliminary tests in August 1946, 1 per cent. summer-oil emulsion failed to control heavy infestations of *T. hicoriae*. In 1947, a single application in June or July of 6 lb. wettable sulphur with 0·6 lb. 40 per cent. wettable dinex per 100 U.S. gals. gave effective control, whereas 0·5 pint HETP [hexaethyl tetraphosphate] per 100 gals. did not. In 1948 and 1949, *T. hicoriae* caused practically no damage on trees treated late in the summer with 25 per cent. wettable parathion in conventional sprays at 1 lb. per 100 U.S. gals. or in concentrated mist sprays at 6 lb. per 115 U.S. gals. for the control of *M. caryaefoliae*, and in 1949, the spray of dinex and wettable sulphur gave good control of heavy infestations.

In August 1950, sprays of 5 lb. wettable sulphur with 0·63 lb. 40 per cent. wettable dinex and of 0·63 lb. 25 per cent. wettable parathion per 100 U.S. gals., applied with a hydraulic sprayer, and of 6 lb. 25 per cent. wettable parathion, 20 lb. copper sulphate and 6 lb. lime per 115 U.S. gals., applied with a mist blower, caused 99, 91 and 90 per cent. mortality of mites; some of those surviving the parathion treatments were probably *Brevipalpus* sp., since subsequent observations indicated that this species is resistant to parathion. Further tests in August and September indicated that it might be possible to add parathion to the DDT sprays used against *Curculio caryae* (Horn), and in 1951, 2 lb. 50 per cent. wettable DDT per 100 U.S. gals., with 1 lb. 15 per cent. wettable parathion, with 1 lb. 15 per cent. wettable parathion and 4 lb. wettable sulphur or with 1 lb. 10 per cent. wettable γ BHC and 0·75–1 lb. 27 per cent. wettable EPN [ethyl p-nitrophenyl thionobenzenephosphonate], was applied with a fungicide on 22nd–23rd May and 30th June and without one on 6th August. The DDT spray with 1 lb. 10 per cent. wettable γ BHC was also applied with bordeaux mixture on 18th–26th May and in late June or early July and with 5 lb. wettable sulphur in early August, and all treatments were very effective against the Pyralid, *Acrobasis caryae* Grote. DDT with parathion and wettable sulphur gave most control of *T. hicoriae* and was also fairly effective against *Brevipalpus* spp., only 5 per cent. of the leaflets being injured by mites. The other treatments resulted in 10–16 per cent. injured leaflets, as compared with about 50 per cent. on untreated trees.

In tests of combined sprays against insects, mites and fungus diseases in 1952, treatment with 1 lb. 12 per cent. wettable γ BHC and 1·5 lb. 15 per cent. wettable Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] per 100 U.S. gals., with 2 lb. 50 per cent. DDT and bordeaux mixture on 26th May and without them on 4th September,

resulted in severe infestation by *Brevipalpus* spp. This did not occur on trees treated with DDT, bordeaux mixture, 4 lb. wettable sulphur and 1 lb. 15 per cent. wettable parathion or 12 per cent. wettable γ BHC per 100 U.S. gals. on 26th May, followed in the second instance by the same spray without bordeaux mixture or DDT on 4th September, on which 14 and 6 per cent. of the leaflets were injured in October; and the percentage was only seven in another orchard following sprays in April, May, June and August of 4 lb. wettable sulphur with 1 lb. 25 per cent. wettable parathion and bordeaux mixture, though it was 42–59 after a similar schedule in which parathion was included in the last application only. *T. hicoriae* caused little or no injury on any of the treated trees.

In tests of treatments from an aeroplane, a concentrated spray of 1 lb. parathion in 5 U.S. gals. per acre in August–September 1952 gave about 98 per cent. kill of a heavy infestation of *T. hicoriae* in 3–4 days and remained effective for the rest of the season. Active stages were affected first, and three or more days were required for the control of newly hatched mites. A severe infestation by *M. caryaefoliae* was also controlled for 3–4 weeks. A dust containing 1 per cent. parathion and 40 per cent. sulphur gave good immediate kill of *T. hicoriae* and controlled the infestation for three weeks when applied at about 50–55 lb. per acre by ground machine; it was more difficult to distribute evenly by aeroplane, but gave 99 per cent. kill in two days. A dust of BHC and sulphur also proved effective, but appeared to be slow in action against the adults.

Bartlett (B. R.). **Retentive Toxicity of Field-weathered Insecticide Residues to Entomophagous Insects associated with *Citrus* Pests in California.**—*J. econ. Ent.* **46** no. 4 pp. 565–569, 1 fig., 4 refs. Menasha, Wis., 1953.

The following is based on the author's summary. The application of insecticides that leave persistent toxic residues to *Citrus* trees in California has permitted increases in some pests formerly kept under natural control and rapid increases in others after initial control, owing to the destruction of natural enemies [*cf. R.A.E.*, A **39** 342]. Tests were therefore made of the comparative effect on the predacious Coccinellid, *Lindorus lophanthae* (Blaisd.), and two parasitic Hymenoptera, *Aphytis chrysomphali* (Merc.) and *Metaphycus helvolus* (Comp.), all of which attack Coccids, of 35 pest-control formulations in commercial use on *Citrus*, by exposing the insects to field-treated leaves brought into the laboratory after standard periods of weathering during which no rain fell. The materials most harmful to them were DDT, parathion, lime-sulphur, DDD (TDE), EPN [ethyl p-nitrophenyl thionobenzenephosphonate] and sulphur, in order of decreasing toxicity, though there was considerable variation in the rate of weathering of parathion and possibly EPN. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] and p-chlorophenyl p-chlorobenzenesulphonate were practically non-toxic. The chemicals showed very little selectivity to the different species, other than that expected on the basis of comparative size and vigour. Under arid conditions, dusts were more toxic than sprays for a given material.

Beck (S. D.). **Effect of Insecticides on the Metabolism and Motility of Mammalian Spermatozoa.**—*J. econ. Ent.* **46** no. 4 pp. 570–574, 9 refs. Menasha, Wis., 1953.

The following is based on the author's introduction and summary. There is a great need for a method of obtaining information concerning the

effects of insecticides on the essential biochemical processes in mammals, including man. The author describes a study of the use of boar's sperm for this purpose. Of the insecticides tested (DDT, p,p′methoxy-DDT (methoxychlor), BHC, aldrin, parathion, malathon and TEPP [tetraethyl pyrophosphate]), only methoxy-DDT had an appreciable inhibitory effect on the oxygen consumption and none but BHC more than a weak inhibitory effect on glycolysis of the washed spermatozoa. All had a distinct inhibitory effect on the motility of the spermatozoa, possibly owing to alterations in the permeability of the cell membrane.

Hayslip (N. C.), Kelsheimer (E. G.), Thames jr. (W. H.) & Wilson (J. W.). **Corn Earworm Investigations in Florida.**—*J. econ. Ent.* **46** no. 4 pp. 574–582, 5 refs. Menasha, Wis., 1953.

Much of the sweet maize produced in Florida has been grown during periods when infestation by *Heliothis armigera* (Hb.) was light, and at these times dusting with 5–10 per cent. DDT has resulted in a high proportion of uninfested ears. However, a less expensive and more effective treatment is needed, especially for use against heavy infestations, and research was therefore begun. The results are given of work in the spring of 1952.

In the first experiment, on the evaluation of insecticides, a 5 per cent. DDT dust was applied to the silks at 35 lb. per acre with a hand rotary duster and sprays to the silks from both sides of the row with a knapsack sprayer. Applications of 4 U.S. quarts 25 per cent. DDT emulsion concentrate with 2·5 U.S. quarts white mineral oil in 50 U.S. gals. spray per acre were made nine times at two-day intervals beginning two days after silks first appeared, and those of the DDT dust and the other sprays (all diluted in 100 U.S. gals. per acre) ten times at two-day intervals beginning when the first silks appeared. The effectiveness of treatment was judged on the percentage of uninfested ears. The most effective treatments were the DDT dust, the DDT emulsion with oil, and a spray of 2 U.S. quarts of another 25 per cent. DDT emulsion concentrate. Of the other emulsion concentrates, 1 U.S. quart 48 per cent. chlordane was no better than no treatment, and 12 oz. 50 per cent. Metacide [containing methyl-parathion and a smaller quantity of parathion], 1 U.S. quart 25 per cent. parathion or malathon, 6·25 per cent. endrin [*cf. R.A.E.*, A **41** 268, note] or 18·75 per cent. dieldrin, and 2 U.S. quarts 25 per cent. p,p′methoxy-DDT (methoxychlor), heptachlor or DDD (rhothane) gave poor to moderate protection, as also did 2 lb. 15 per cent. wettable parathion.

In the second test, to compare DDT formulations, 4 U.S. quarts of a 25 per cent. technical DDT emulsion concentrate and 2·5 U.S. gals. mineral oil in 50 U.S. gals. spray per acre, applied four times at three-day intervals by hand sprayers, was more effective than the same spray without oil or a similar one prepared from a concentrate containing only 12·5 per cent. DDT, no more effective than one in which the concentrate was used at 3 U.S. quarts per acre, and less effective than when applied six times at two-day intervals with a power sprayer. The mixture of solvent, emulsifier and oil without DDT gave very poor control. A spray of 6 lb. 50 per cent. wettable DDT in 50 U.S. gals. per acre was inferior to 10 per cent. DDT dust, applied every other day at 35 lb. per acre, and this was slightly less effective than the DDT emulsion without oil. The emulsion sprays were most effective when the emulsifier used was Atlas G1087 and the solvent was Velsicol AR50 or Velsicol AR50G. No yield differences and only slight differences in pollination and the filling of ear tips due to treatment were observed, although all oil sprays caused some yellowing of the plants.

In the third test, to determine the best number and timing of applications of DDT, it was found that the variety of sweet maize used required protection for 14 days after silking, that increasing the number of applications improved control by extending the period of protection, and that increasing the interval between them had the same effect, provided that it was not so long as to allow the application to become ineffective; when only 3–4 applications were made, delaying the date of the first until 3–4 days after silking gave the best protection. The most effective interval between applications varied with the total number of applications and with the formulation. Three and four applications of 4 U.S. quarts 25 per cent. DDT emulsion concentrate and 2·5 U.S. gals. oil in 50 U.S. gals. spray per acre were most effective (72 and 87·2 per cent. uninfested ears) at intervals of 96 and 72 hours, respectively; eight of 5 per cent. DDT dust at 24-hour intervals gave 72 per cent. uninfested ears and seven at 48-hour intervals only 38 per cent., indicating that DDT dusts should be applied at shorter intervals than sprays of DDT and oil. No improvement in control seemed likely from increasing the number of applications of DDT and oil beyond five. DDT with oil was again superior to a similar spray without oil or the DDT dust.

In the last test, on the technique of application, sprays containing 2 lb. DDT and 2·5 U.S. gals. oil per acre were applied by power sprayer. There were no significant differences in control between rates of 65, 100 and 125 U.S. gals. spray per acre, between spray angles of 65, 80 and 110° in flat fan nozzles, or between two 110° nozzles and two 80° nozzles per row, though these were more effective than five 65° nozzles.

It is concluded that 2 lb. technical DDT per acre in an emulsifiable formulation containing 5 per cent. Triton X-155 and 70 per cent. xylene by weight, combined with 2·5 U.S. gals. Blandol and 65–125 U.S. gals. water to make a spray and applied with two 80° flat fan nozzles per row will give satisfactory control of *H. armigera* under most conditions.

Steinhaus (E. A.) & Bell (C. R.). **The Effect of certain Microorganisms and Antibiotics on stored-grain Insects.**—*J. econ. Ent.* **46** no. 4 pp. 582–598, 13 refs. Menasha, Wis., 1953.

The following is based on the authors' summary. An account is given of tests showing that *Calandra* (*Sitophilus*) *granaria* (L.), *C.* (*S.*) *oryzae* (L.), *Rhizopertha dominica* (F.) and *Tribolium confusum* Duv. in stored wheat are in general not very susceptible to entomogenous microorganisms (bacteria, fungi and protozoa) under conditions optimum for the growth and development of the insects. Of the microorganisms tested, only *Bacillus thuringiensis* [*cf. R.A.E.*, A **40** 154] showed significant pathogenicity for *C. granaria* and *C. oryzae*; certain others occasionally infected the test insects, but the infections could not be uniformly initiated and there appeared to be no real possibility of their practical use for control. In the tests with *Calandra* spp., *B. thuringiensis* did not infect more than 90 per cent. of the weevils, and there was some indication that the population is able to overcome the infection and increase rapidly to a point surpassing that in untreated grain, so that, although the possibility of controlling insects in stored grain by means of this bacterium exists, there is not much promise that control would be as rapid as with the best insecticides.

Preliminary investigations made in view of the possibility of depriving the insects of their intracellular bacterial symbiotes by means of antibiotics showed that these drugs were toxic to most of the test insects. Relatively large doses (0·3–0·5 gm. per 14 gm. grain) of aureomycin, bacitracin, chloromycetin, penicillin G, polymixin B, streptomycin and terramycin killed all

adults of *C. granaria* and *C. oryzae* within 30–60 days. Similar results were obtained with *Tribolium*, but *Rhizopertha* was more or less neutral to terramycin, was killed by streptomycin and appeared to be slightly stimulated reproductively by chloromycetin. There was no significant difference between the reactions of *C. granaria* and *C. oryzae* to terramycin.

Massey (C. L.), Chisholm (R. D.) & Wygant (N. D.). **Ethylene Dibromide for Control of Black Hills Beetle.**—*J. econ. Ent.* **46** no. 4 pp. 601–604, 2 refs. Menasha, Wis., 1953.

Fuel-oil solutions of o-dichlorobenzene have been applied extensively to felled trees to control infestation by the Black Hills beetle [*Dendroctonus ponderosae* Hopk.] in the pine forests of the western United States since 1940, and proved equally effective when applied to standing trees in 1947. Application at the rate of 1 gal. o-dichlorobenzene in 6 gals. fuel oil has been the standard method of control since 1948, but the material is costly and disagreeable to use, and tests of emulsions prepared from concentrates of various fumigants were therefore begun in 1949.

Emulsified solutions of ethylene dibromide in various solvents were tested during the summer, when the insects varied from mature larvae to callow adults, and Stanisol and fuel oil proved effective as solvents; about 2 lb. ethylene dibromide in 5 U.S. gals. emulsion was the minimum satisfactory dosage, and about 10 per cent. of the solvent was needed. In 1950, ethylene dibromide was tested with fuel oil, Stanisol, heavy aromatic naphtha and Solvesso 100 as the solvents, dichloroethyl ether, o-dichlorobenzene and nitrobenzene with Stanisol, and o-nitrochlorobenzene with Solvesso 100, each concentrate containing 8 oz. of a mixture of Triton X-100 (an alkylated aryl polyether alcohol) and Triton B-1956 (a modified phthalic glycerol alkyd resin) per U.S. gal., and the emulsified solutions were applied to the bark to the run-off point in May against the larvae and in late June and early July against the pupae and adults at the rate of about 3 U.S. gals. per tree to a height of 20 ft. Ethylene dibromide was the only satisfactory material and was effective at the rate of 1 lb. in 5 U.S. gals. emulsion, but a concentration of 2 lb. per 5 U.S. gals. is recommended against pupae and adults, which are more resistant than larvae. Both fuel oil and Stanisol proved satisfactory solvents and gave adequate penetration of the bark provided that they comprised 15–20 per cent. of the final spray, though lower concentrations were effective against larvae only.

A few tests were made with solutions of the fumigants in fuel oil; 0·75–3 lb. ethylene dibromide, 8 lb. o-dichlorobenzene and a mixture of 4 lb. o-dichlorobenzene and 4 lb. p-dichlorobenzene per 5 U.S. gals. oil gave consistent control of larvae, pupae and adults, the first being the most economical.

As a result of the experiments, an emulsion concentrate containing 2 lb. ethylene dibromide and 8 oz. emulsifier with enough no. 1 fuel oil to make 1 U.S. gal. is recommended; it should be diluted with 4 U.S. gals. water for use.

Allen (N.), Hodge (C. R.), Hopkins (A. R.) & Early (J. D.). **Tobacco Hornworm Control with Organic Insecticides.**—*J. econ. Ent.* **46** no. 4 pp. 604–608, 2 figs., 7 refs. Menasha, Wis., 1953.

Small-scale field tests were carried out at Florence, South Carolina, in 1950–52 on the use of organic insecticides against larvae of *Protoparce sexta* (Joh.) on tobacco. Dusts were applied by hand rotary duster at 20–35 lb.

per acre and sprays with small traction sprayers with an adjustable boom and a shield to protect the operator. High- and low-volume sprays were applied at about 75 and 18 U.S. gals. per acre, respectively; in the following, the quantities of actual insecticide in lb. per acre are given in parentheses.

In small-plot tests in 1950, dusts of DDD (TDE) (3) and toxaphene (6·4) and high-volume sprays of DDD (3), alone and with parathion (0·11), and of toxaphene with parathion (2·4 and 0·11) all gave 99–100 per cent. reduction in living larvae in 54 hours, but DDD was slower in action when used alone than when parathion was added, and this was confirmed in all later tests with these materials. In field-plot tests, dusts containing DDD (2·6), DDD with parathion (1·9 and 0·19), toxaphene (5·4), toxaphene with parathion (2·9 and 0·29) and undiluted cryolite (2·7), a high-volume wettable-powder spray of DDD with parathion (3 and 0·11) and low-volume emulsion sprays of DDD (1), and toxaphene (2) gave 89–100 per cent. reduction in 54–96 hours, whereas a low-volume emulsion spray of toxaphene (1) gave only 77 per cent. Emulsion sprays applied at 2 lb. active ingredient per acre caused some damage to maturing tobacco leaves, and toxaphene imparted an undesirable flavour and aroma to cigarettes, whereas DDD appeared to have no detrimental effect except when a petroleum distillate was used as the solvent.

In 1951, dusts of DDD alone (3·5) and with parathion (1·4 and 0·28) and low-volume emulsion sprays of DDD (1) with standard solvent and with xylene as solvent and of CS-708 [a 1 : 2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] (1) in xylene all gave 99–100 per cent. reduction in living larvae in 68 hours, and none had any detrimental effect on the tobacco. In growers' fields, a dust containing 1 per cent. endrin [*cf. R.A.E.*, A **41** 268, note] gave very good control. In high-volume emulsion sprays in 1952, endrin (0·5) killed a high proportion of the larvae in a short time and was more effective than DDD (1), whereas malathon (0·5) was relatively ineffective. In other tests, endrin in high-volume sprays killed the larvae more quickly at 0·6 than at 0·3 lb. per acre, though both rates were effective, and was better than CS-708 (1·5) at the higher rate. It killed a high proportion of the larvae within eight hours and was much more rapid than DDD, CS-708 or CS-728 [50 per cent. of a chlorinated product of 1-p-chlorophenyl-1-phenyl-2-nitrobutane].

It is pointed out that to be effective, an insecticide should give more than 95 per cent. kill in less than three days, as a few large larvae can spoil a tobacco crop in a few days and rain is likely to wash part of the deposit off the leaves. DDD was the most satisfactory insecticide tested up to 1952, but endrin may prove valuable if it is otherwise satisfactory for use on tobacco. DDD dusts and sprays, in many instances with the addition of parathion, which also controlled *Myzus persicae* (Sulz.), were used successfully by many growers in 1952.

White (G. D.). **Weight Loss in stored Wheat caused by Insect Feeding.** — *J. econ. Ent.* **46** no. 4 pp. 609–610, 2 graphs, 1 ref. Menasha, Wis., 1953.

In controlled experiments to determine the actual loss of weight caused by the development of larvae of *Calandra* (*Sitophilus*) *oryzae* (L.) within wheat grains, adult females were allowed to oviposit in samples of uninfested wheat for two days and then removed, and the samples were weighed at weekly intervals until emergence of the progeny was complete. The samples were maintained at a constant temperature of 80°F. and 70 per

cent. relative humidity, and adults were removed as they emerged, 4–5 weeks after the beginning of the experiment. The loss in weight caused per week increased from the first to the fourth week after egg deposition and declined slightly in the fifth, during pupation and adult emergence. Infested kernels were detected by radiograph [*R.A.E.*, A **39** 246], and the mean total losses in weight per infested kernel were 0·67, 2·36, 6·52, 13·59 and 20 per cent. after 1, 2, 3, 4 and 5 weeks of larval development, respectively. The weight of the excreta, cast skins, pupal cases and frass left within the kernels was not determined. The average weight of the newly emerged adults was 3·76 per cent. of the average weight of a whole kernel of wheat, or about one-fifth of the weight loss per kernel caused by the development of the larva. Only the net weight loss, due to the metabolic processes of the immature stages of the weevil, was considered, and 68 per cent. of it occurred during the first four weeks of development, when there was no outward evidence of infestation.

Bacon (O. G.), Anderson (L. D.) & Reynolds (H. T.). **Control of Corn Earworm attacking Sweet Corn in California.**—*J. econ. Ent.* **46** no. 4 pp. 614–620, 2 refs. Menasha, Wis., 1953.

Further tests were made in 1951 with DDT and other chlorinated-hydrocarbon insecticides for the control of *Heliothis armigera* (Hb.) on sweet maize in California [*cf.* *R.A.E.*, A **40** 106, 112]. Dusts were applied to individual ears with a one-inch stencil paint brush 3–4 times at intervals of 3–4 days, beginning 2–4 days after the first silks appeared, and each silk mass was treated at each application. Emulsion sprays were applied with hand-operated trigger apparatus at the rate of 1–1·5 cc. per ear to individual ears three times at about the same intervals as the dust treatments or with a fixed-nozzle boom on a tractor sprayer; this sprayed two rows of plants at a time from four nozzles per row, covering 18–24 inches of the plant at ear height from both sides, and 2–4 applications were made at intervals of about three days. The dusts were applied at 30–40 lb., the sprays to individual ears at 6–8 U.S. gals. and the boom spray at 25–50 U.S. gals. per acre.

Dusts containing 1–5 per cent. DDT or 1 per cent. isodrin or endrin [*cf.* **41** 268, note] gave 90–97, 86–97 and 92–96 per cent. uninfested ears at harvest, and 5 per cent. DDD (TDE), ethyl-DDD (Q-137) or Compound 1189 (2,3,3a,4,5,6,7,7a,8,8-decachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene-1-one) and 1 per cent. CS-708 [a 1 : 2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] gave 80 per cent. or more, as compared with 4–6 per cent. for no treatment. Ground soapstone alone gave 50 per cent., indicating that accumulations of dust in the silks kill the eggs or newly hatched larvae. In individual ear sprays, all containing 5 per cent. oil, 0·75 per cent. DDT was not significantly more effective than 0·75 per cent. DDD or ethyl-DDD or 0·05 per cent. endrin, and all gave more than 90 per cent. uninfested ears at harvest, as compared with 5 per cent. for no treatment; 0·05 per cent. isodrin and 0·75 per cent. p,p′ methoxy-DDT (methoxychlor) gave only 85 and 82 per cent. The husks were scorched when Sovaspray 100 oil (an isoparaffinic fraction in the approximate distillation range of kerosene) was substituted for U.S.P. grade mineral oil in the DDT spray and when DDD and methoxy-DDT were used. Emulsion sprays containing 0·5 or 0·75 per cent. DDT and 2·5, 5 or 10 per cent. oil, applied at 2–3 cc. per ear with the stencil brush were as effective as the spray-gun applications, but caused more ear damage. Individual ear sprays resulted in the smallest DDT residues on the plants or ears.

In tests with the boom apparatus, 3–4 applications at intervals of 3–4 days of emulsion sprays containing 0·75 per cent. DDT and 10 per cent. mineral oil at 50 U.S. gals. per acre gave 90–98 per cent. uninfested ears at harvest and were slightly more effective than 0·5 per cent. DDT with 5–10 per cent. mineral oil applied at the same rate; the first spray applied 2–4 times at 25 U.S. gals. per acre gave poor control. Ethyl-DDD at 0·75 per cent. and endrin and isodrin at 0·05 per cent. gave significantly poorer control (73–84 per cent. uninfested ears) than DDT at 0·75 per cent. (98 per cent.) when applied with 10 per cent. oil at 50 U.S. gals. per acre. Slight yellowing was observed on all plots treated with the boom sprayer.

In 1950–51, large areas were dusted by the brush method with no injurious effect on pollination. This method is slow and requires accurate timing; under ordinary conditions, 3–4 applications should be made at intervals of not more than three days, beginning 1–2 days after the silks appear. Individual ear sprays need less accurate timing; 2–4 applications should be made, depending on the rapidity and uniformity of silking. Boom sprays have shown promise against moderate infestations, but not against extremely severe ones. Application is rapid and the risk of plant damage slight, but timing is most important; applications should begin as nearly as possible when the first silks appear, or possibly just before if infestation is severe, and be repeated at intervals of 3–4 days.

Beckman (H. F.), Bruckart (S. M.) & Reiser (R.). **Laboratory Culture of the Pink Bollworm on chemically defined Media.**—*J. econ. Ent.* **46** no. 4 pp. 627–630, 16 refs. Menasha, Wis., 1953.

The most satisfactory artificial medium for rearing larvae of *Platyedra (Pectinophora) gossypiella* (Saund.) in the laboratory proved to be a modified chick ration, the constituents of which are shown, having egg albumen as the protein constituent and rendered almost completely water-soluble by the use of crystalline vitamins and dextrose; it was heated to coagulate the albumen. When it contained only 1 per cent. fat, it supported slow larval growth but no development beyond the pupal stage. The inclusion of 5 and 10 per cent. fat permitted more rapid growth and the production of a few adults, but the most rapid growth and the largest number of adults were obtained when 20 per cent. fat was included. The better results with fat levels above 5 per cent. were probably due to the physical properties imparted to the medium rather than to any added nutritive quality. The addition of purified cotton linters introduced bulk and resulted in a medium with air spaces, attracted the larvae and permitted them to tunnel; larvae in the fourth instar appeared to consume the linters. Attempts to supply desirable texture by means of other inert materials were unsuccessful. The moisture content of the medium should be kept high and fairly constant, and a temperature of 26–29°C. [78·8–84·2°F.] proved satisfactory.

Ivy (E. E.), Rainwater (C. F.), Scales (A. L.) & Gorzycki (L. J.). **Comparative Effectiveness of the Ethyl and Methyl Homologs of nine Phosphorus Compounds against four Cotton Pests.**—*J. econ. Ent.* **46** no. 4 pp. 630–633, 12 refs. Menasha, Wis., 1953.

Although phosphorus insecticides incorporating ethyl groups are usually more toxic to insects than their methyl homologues, this is not true for all insects, possibly owing to differences between the enzymes of the different species. *Anthonomus grandis* Boh. is apparently one of the insects

to which it does not apply [*cf. R.A.E.*, A **39** 7]. Tests were therefore carried out in which *A. grandis*, *Aphis gossypii* Glov., *Alabama argillacea* (Hb.) and the mite, *Tetranychus desertorum* Banks, were exposed to parathion, O,O-diethyl O-7-hydroxy-4-methyl-coumaryl thiophosphate (Potasan), ethyl p-nitrophenyl thionobenzenephosphonate (EPN), ethyl o-nitrophenyl thionobenzenephosphonate (EON), O,O-diethyl O-2-chloro-4-nitrophenyl thiophosphate, O,O-diethyl S-carbamylmethyl dithiophosphate, O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate (Systox [demeton]), O,O-diethyl S-(2-oxo-2-ureidoethyl) dithiophosphate (3885), tetraethyl dithiopyrophosphate, and their methyl homologues. The materials were formulated with an emulsifier, xylene and water immediately before each test and applied to cotton in field or laboratory cages as sprays at the rate of 15 U.S. gals. per acre. The test periods were five days for *Anthonomus* and *Alabama*, and three days for the other species. Dosage-mortality curves were plotted from the results, and it was found that the median lethal dosages for *Anthonomus* of all methyl homologues but tetramethyl dithiopyrophosphate were lower than those of the corresponding ethyl compounds; methyl-parathion was 13·6 times as toxic as parathion, but the differences were slight for some pairs. Against the Aphid, all the ethyl compounds except parathion and O,O-diethyl O-2-chloro-4-nitrophenyl thiophosphate had lower median lethal dosages than the corresponding methyl homologues; most were 2–3 times as effective, but Systox was nearly six and O,O-diethyl S-carbamylmethyl dithiophosphate 58·7 times as toxic as the methyl homologue. Against *Alabama*, the ethyl compounds were the more effective of five pairs and the methyl compounds of four pairs of homologues, and against the mite, all the ethyl compounds but O,O-diethyl S-carbamylmethyl dithiophosphate were more effective than their methyl homologues.

It is concluded that *Anthonomus* is an exception to the general order of susceptibility, but that there are variations for each species, and no consistent pattern was detected in the results.

Parencia jr. (C. R.) & Cowan jr. (C. B.). **Field Tests with Sprays for the Control of Thrips and the Cotton Fleahopper.**—*J. econ. Ent.* **46** no. 4 pp. 633–638, 2 refs. Menasha, Wis., 1953.

Frankliniella exigua Hood and *F. fusca* (Hinds) were injurious to cotton in Texas early in the season in 1952 and *Psallus seriatus* (Reut.) in mid-season. Various insecticides were tested in concentrated emulsion sprays against them from early June and in late June and early July, respectively, and the effect of those used against *P. seriatus* on infestation by *Heliothis armigera* (Hb.) was investigated. The sprays were applied at 1·5 U.S. gals. per acre in small plots and at 2 U.S. gals. per acre in large-scale tests, and the amounts given below are those of actual toxicant per acre.

Three applications were made against the thrips at approximately weekly intervals, beginning on 3rd–5th June, when the cotton was in the four-leaf stage. Effective control throughout the season was given by 0·0625–0·1 lb. dieldrin, 0·75 lb. toxaphene, 0·125 lb. aldrin, 0·125–0·25 lb. heptachlor and 0·25 lb. EPN [ethyl p-nitrophenyl thionobenzenephosphonate], whereas 0·125 lb. EPN, 0·1 lb. endrin or isodrin [*cf. R.A.E.*, A **41** 268, note] and 0·15 lb. γ BHC (alone or with 0·25 lb. DDT) were less persistent in their effects.

It is important not to apply insecticides so late as to destroy the natural enemies of *H. armigera*, and since *P. seriatus* is susceptible to low doses of most organic insecticides, several tests were made to determine the best for use at mid-season, when control of only *P. seriatus* was required; such an insecticide should remain toxic for 10–14 days, so that one

light application would afford control without destroying beneficial insects. Small-plot tests proved unsatisfactory for evaluating insecticides against *P. seriatus*, but records made one day after treatment in large-scale experiments showed good initial kill with 0·75 lb. toxaphene, 0·1 lb. dieldrin, isodrin or endrin, 0·125 lb. aldrin, heptachlor or EPN or 0·15 lb. γ BHC with 0·25 lb. DDT. Counts made 6–13 days after treatment showed that toxaphene, dieldrin, endrin and BHC with DDT gave the best residual control, aldrin, heptachlor, EPN and isodrin being inferior in this respect.

Examination of the small plots during the fortnight following treatment against *P. seriatus* showed that injury to the bolls by *H. armigera* was significantly higher after one application of 0·125 lb. EPN than after one of 0·75 lb. toxaphene, 0·125 lb. aldrin or 0·1 lb. endrin, and the same trend was evident in the large-scale tests.

Fulton (R. A.), Sullivan (W. N.) & Mangan (G. F.). **Effectiveness of Lindane Vaporizers.**—*J. econ. Ent.* **46** no. 4 pp. 639–641, 1 fig., 3 refs. Menasha, Wis., 1953.

An account is given of experiments on the functioning of an electrically-heated device for dispersing vapour of γ BHC as lindane in enclosed spaces [*cf. R.A.E.*, A **40** 351] and the concentration of vapour likely to be present in a treated space. The vapour concentrations are given in mmg. per litre; multiplication by 28·3 converts them to mg. per 1,000 cu. ft. The tests were made in a room with a capacity of about 11,000 cu. ft. and having three large windows and two doors. Lindane was vaporised at about 1 gm. per day from a Pyrex cup fixed to an outside wall about 6 ft. from the floor and 5 ft. from the ceiling; the temperature of the air between the heating element and the cup was 118°C. Concentrations of lindane vapour per litre of air in different parts of the room varied only from 0·11 to 0·18 mmg. when there was no ventilation and from 0·042 to 0·049 mmg. when all the windows and one door were open, but when one window and one door were open, there was a wide variation (0·05 to 0·3 mmg.) caused by air eddies. When the air was circulated through an air-conditioning unit, the amount of lindane in the water removed (about 2 U.S. gals. per day) had little effect on the concentration remaining.

A lindane concentration of 0·067 mmg. per litre was highly effective against house-flies [*Musca domestica* L.] exposed to it for a short period, but much longer exposures to considerably higher concentration was required for appreciable mortality of cockroaches. Mortalities of the confused flour beetle [*Tribolium confusum* Duv.] exposed for seven or 11 days to a concentration of 0·17 mmg. per litre or for three days to one of 0·33 mmg. built up by four vaporisers were 0, 10 and 98 per cent., and the corresponding figures for carpet-beetle larvae [? *Anthrenus scrophulariae* (L.)] were 0, 0 and 4.

Hanna (R. L.) & Mistric jr. (W. J.). **Effect of Different Treatment Schedules for Control of Cotton Insects.**—*J. econ. Ent.* **46** no. 4 pp. 641–644, 4 refs. Menasha, Wis., 1953.

Further investigations on the control of insects attacking cotton in Texas by early and late applications of insecticides were carried out at College Station in 1952 [*cf. R.A.E.*, A **40** 355]. In the first test, three early spray applications were made at intervals of 7–10 days, beginning when the cotton had 4–8 leaves, two on the second and third of these dates or one on the third only, toxaphene being used at about 0·9 lb. per acre on the first two and at 1·6 lb. (to kill overwintered adults of *Anthonomus grandis*

Boh.) on the last. Late applications to control *Anthonomus* became necessary in all plots in early July and were continued at 5-day intervals until mid-August against both this weevil and *Heliothis armigera* (Hb.). Statistical analysis showed that control of thrips was better on plots receiving three early applications than on those receiving two and on these than on those receiving only one, but indicated no significant differences in the control of *A. grandis*, *H. armigera* or *Psallus seriatus* (Reut.) or in yield. Plants sprayed early in the season reached maximum fruiting about a week before untreated cotton.

In the second test, a dust containing 2·5 per cent. dieldrin and 40 per cent. sulphur was used until infestation by *H. armigera* necessitated the addition of 5 per cent. DDT. It was applied early in the season as before (at 5 lb. per acre on the first two dates, and 11 lb. on the third), late in the season (at 13 lb. per acre), either nine times at 4-day intervals or five times at 8-day intervals, or both early and late. Only plots receiving three early-season treatments had significantly fewer thrips than untreated plots. Those treated late in the season showed significantly less damage by *Anthonomus* than the others, but the difference between the 4- and 8-day intervals was not significant. The differences in yield observed appeared to depend on control of *Heliothis*, plots receiving late-season treatment showing significantly less bollworm injury and yielding twice as much seed cotton as others, and those receiving late treatment every four days showing significantly better bollworm control and yields than those treated every eight days. Early treatments did not increase yield or cause earlier fruiting.

In the third experiment, mixtures of aldrin or dieldrin with DDT (1 : 2) and of toxaphene with DDT (2 : 1) were applied in sprays at 0·8 and 2·9 lb. active ingredient, respectively, per acre nine times at 4-day intervals or five times at 8-day intervals from 2nd July to 6th August. The mixtures of toxaphene and dieldrin with DDT controlled *Anthonomus* better at 4-day than at 8-day intervals and were superior to the aldrin mixture, which was not significantly better at 4- than at 8-day intervals. There were no significant differences in weevil control between the three mixtures applied at 8-day intervals. All treatments protected the cotton from damage by the relatively small population of *Heliothis* present. Good weevil control did not result in increased yields, probably because of drought.

Ditman (L. P.), Kramer (A.) & Saulsbury jr. (A. O.). **Performance of Malathon for Control of the Pea Aphid.**—*J. econ. Ent.* **46** no. 4 pp. 645–648, 6 refs. Menasha, Wis., 1953.

The following is based on the authors' summary of further investigations on the control of the pea Aphid [*Macrosiphum pisum* (Harris)] on peas in Maryland [*cf. R.A.E.*, A **41** 147] carried out in the spring of 1952. Commercial ground sprays of 1·5 U.S. pints 50 per cent. malathon emulsion concentrate in 25 U.S. gals. water per acre, applied in May with a boom sprayer designed for treating broadcast peas, gave an excellent initial kill of the Aphid and protected the crop from a recurrence of infestation. When conditions were favourable, sprays of 1·5 and 2 U.S. pints of the concentrate in 3–5 U.S. gals. water per acre from an aeroplane gave comparable results, but their effectiveness was reduced during unfavourable weather, particularly when there was wind. No malathon residues could be detected chemically on the plants or on the canned peas when a period of slightly more than two weeks elapsed between treatment and harvest. The quality and flavour of the canned peas were not impaired even by the heaviest ground sprays.

Newton (J. H.), Palmer (M. A.) & List (G. M.). **Fall Migration of Aphids with special Reference to the Green Peach Aphid.**—*J. econ. Ent.* **46** no. 4 pp. 667–670, 7 refs. Menasha, Wis., 1953.

The following is based on the authors' introduction and summary. In view of the finding that *Myzus persicae* (Sulz.) is a vector of the peach mosaic virus [*R.A.E.*, A **36** 79] and the possibility of controlling it on peach by autumn treatment with persistent insecticides [*cf.* **36** 92], investigations on the migration of this and other Aphids to peach in Colorado were made in the autumns of 1946 and 1947. Trap boards covered with adhesive were hung in peach orchards near Palisade, and Aphids of 44 species were collected between early September and mid-December, detailed records being shown in tables. *M. persicae*, of which the viviparae and males were taken in greatest numbers in late September and October or November, respectively, was the only species to produce winter eggs on peach, but autumn feeding by other species occurred, since numerous colonies of immature oviparae of *Amphorophora lactucae* (L.) (*sonchi* (Oestl.)) and oviparae of *Hyalopterus arundinis* (F.) and *Rhopalosiphum prunifoliae* (Fitch) were observed. The oviparae of *M. persicae* do not become mature unless green foliage is available, and early leaf-fall is important in limiting the production of winter eggs. Lists are given from the literature of the summer and winter food-plants of the 13 species taken most frequently on the traps, showing which occur in Colorado.

Gunther (F. A.), Reynolds (H. T.) & Jeppson (L. R.). **Field Compatibility of Aramite and Sulfur in California.**—*J. econ. Ent.* **46** no. 4 pp. 674–677, 4 refs. Menasha, Wis., 1953.

Following conflicting reports as to the compatibility of Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) with sulphur, investigations were carried out in California in which cotton and lima-bean foliage was dusted with 3 per cent. Aramite, alone or with 55 per cent. sulphur, lima-bean foliage was dusted with 3 per cent. Aramite over a fresh application of 98 per cent. sulphur, and lemon leaves were sprayed with 2 lb. 15 per cent. Aramite per 100 U.S. gals., with or without the addition of 50 per cent. sulphur to the wettable powder. It was found that the rate of disappearance of Aramite on all three plants was directly proportional to the concentration applied, and the presence of sulphur did not appear to affect the half-life of the residue. The half-life is defined as the time required for a given deposit to decrease by half and is regarded as a useful measure of persistence. Spray residues on lemon had a longer half-life than dust residues on cotton or bean foliage, and the reasons for this are discussed. On both cotton and lemon, the initial deposit was considerably lower from the mixture than from Aramite alone, probably as the result of poor formulation, and this may indicate an inherent difficulty in combining Aramite with sulphur.

Merrill jr. (L. G.) & Hutson (R.). **Maggots attacking Michigan Onions.**—*J. econ. Ent.* **46** no. 4 pp. 678–680, 5 refs. Menasha, Wis., 1953.

In further studies of the Diptera responsible for the serious damage to onion in Michigan [*cf. R.A.E.*, A **40** 122], over 50 species, lists of which are given, were collected from onion fields (20 of them from the growing onions) or neighbouring heaps of rejected onions in nine counties in 1949–52. Only seven species were of importance as pests, and of these, *Hylemyia antiqua* (Mg.) was the most numerous [*cf. loc. cit.*], although nearly a fifth of the adults reared in May and June were *H. cilicrura* (Rond.).

When both species were present, *H. cilicrura* was proportionately most numerous early in the year, and gravid females of this species were collected earlier in the season than those of *H. antiqua*. Where *H. cilicrura* predominates, control measures should probably be applied soon after planting or in the form of seed treatment. After June, few larvae of *H. cilicrura* were found, though adults were taken in the fields.

Adults of the overwintering generation of *Eumerus strigatus* (Fall.) and *E. tuberculatus* (Rond.) emerge from mid-May and oviposit on self-sown bulbs and rejected onions. Those of the next generation emerge in late June and oviposit on the growing onions, on which larvae were found in July and August. Most *Eumerus* larvae were found in fields already infested by *Hylemyia*, but *E. tuberculatus* was observed to have initiated an infestation in bulbs (possibly slightly infected by the smut, *Urocystis cepulae*) in one field in July. Numerous larvae were found overwintering in muck soil at a depth of 1–2 ins. after heavy infestations. *Muscina stabulans* (Fall.) and *M. assimilis* (Fall.) were active throughout the season; the larvae became more numerous each year, but were never primary invaders. *Euxesta notata* (Wied.) was fairly numerous late in the season, but was a secondary pest and relatively rare in growing onions.

H. antiqua was the predominant species in the reject heaps during the first autumn and spring after their formation, and did not occur in them later, indicating that culled onions should be destroyed at harvest or before the next spring. After their first spring, the heaps contained a great variety of scavengers, predators and incidental pests. The Syrphid, *Syritta pipiens* (L.), which is not a major pest of growing onions, but was taken from one heavily infested field in August, was very numerous, and some secondary field pests, such as *Eumerus* spp. and *Euxesta notata*, were found; destruction of the heaps would contribute to the reduction of these.

Douglas (W. A.) & Smith (C. E.). **Control of Corn Earworm and Rice Weevil in Dent Corn with DDT-Mineral Oil Emulsions.**—*J. econ. Ent.* **46** no. 4 pp. 683–684, 2 figs. Menasha, Wis., 1953.

Heliothis armigera (Hb.) and *Calandra* (*Sitophilus*) *oryzae* (L.) are the major pests of maize in most of the Gulf coast area of the United States, and emulsion sprays containing DDT and mineral oil were tested for their control in Louisiana in 1952. Sprays of 1·2 or 0·8 lb. DDT, each with 1 or 1·6 U.S. gals. mineral oil in 20 U.S. gals. water containing 0·5 per cent. emulsifier, were applied with a compressed-air sprayer at 20 U.S. gals. per acre on 11th July, when 15 per cent. of the silks had appeared, and on 14th and 17th July, and ears were harvested and examined on 14th November. All sprays gave almost perfect control of *H. armigera*, and almost completely prevented infestation by *C. oryzae*. Interference with pollination was slight and could probably have been reduced by the use of smaller dosages. There was no injury by other insects in any treated plot, whereas ears in untreated plots were injured by *Laphygma frugiperda* (S. & A.) and *Pyroderces rileyi* (Wlsm.), in addition to *H. armigera* and *C. oryzae*, by rot-producing organisms and by the feeding of birds on the insects and on the kernels they had exposed.

Van Leeuwen (E. R.). **Tests of Insecticides for Control of Chestnut Weevil Larvae in the Soil.**—*J. econ. Ent.* **46** no. 4 pp. 684–685. Menasha, Wis., 1953.

Larvae of *Curculio auriger* (Csy.) and *C. proboscideus* F. leave the chestnuts in which they have developed and enter the soil to pupate [*cf. R.A.E.*,

A **41** 213–214], and tests of organic insecticides to control them in the soil were begun in Maryland in 1949. In laboratory tests, in which the chemicals were mixed with soil and larvae allowed to enter, toxaphene at 2–25 lb. per acre gave 40–64 per cent. mortality of *C. auriger* and 60–100 per cent. of *C. proboscideus* in 30 days, and chlordane at 5–25 lb., 46–62 and 80–100 per cent., respectively; BHC (25 per cent. γ isomer) at 15–25 lb. and parathion at 2–25 lb. per acre gave complete mortality of both species. Mortality in untreated soil was 16 per cent. for *C. auriger* and 64 per cent. for *C. proboscideus*. When the soil was treated with parathion two months before the larvae were allowed to enter it, rates of 0·5–4 lb. per acre gave 84–98 and 80–99 per cent. mortality of *C. auriger* and *C. proboscideus*, respectively, and 6 lb. per acre was required for complete mortality, indicating that the compound vaporises rapidly. In a field test, treatment with 50–100 lb. chlordane, 5–40 lb. BHC (25 per cent. γ isomer) or 5–50 lb. parathion per acre, applied in sprays to the soil surface, and 5–50 lb. parathion, mixed with sand and scattered by hand, followed by disking twice to a depth of five inches, gave very poor control of larvae of either species liberated on the treated soil in autumn and recovered from it in the following spring, whereas mixing 20–50 lb. parathion per acre with the soil by hand to a depth of five inches gave complete kill of both, though such a method is too laborious to be practicable.

In tests of fumigants, parathion, carbon bisulphide and dichloroethyl ether at dosages of 25–65 lb. per acre, ethylene dibromide at 5–85 lb. and D-D mixture [1,3-dichloropropene and 1,2-dichloropropane (*cf.* **37** 290)] at 10–45 lb. were mixed with acetone (1 : 272) and injected at a depth of five inches into the soil in pots containing larvae of *C. auriger*. Examination after a month showed that D-D at 25–45 lb. per acre and all doses of ethylene dibromide above 10 lb. per acre gave complete kill; the other materials were less effective and acetone alone was not toxic. In field tests, larvae of *C. auriger* that had just left the nuts were allowed to burrow into soil plots in the autumn of 1949, and these were treated with ethylene dibromide in May 1950. Examination a month later showed that the mortality percentages were 53–89 for doses of 5–20 lb. per acre and 92 and 97 for 25 and 40 lb.; applications of D-D mixture at 8–12 U.S. gals. and of 41 per cent. ethylene dibromide at 4–5 and over 9 U.S. gals. per acre in July 1950 gave 98–99, 99 and 100 per cent. kill, respectively, in a month. Injections of 10 U.S. gals. 41 per cent. ethylene dibromide at a depth of five inches in the autumn of 1950 gave 98 per cent. reduction of *C. proboscideus*.

Examination of soil into which 1 ml. of the ethylene dibromide had been injected at a five-inch depth showed that 99 per cent. of the larvae within six inches of the injection point were killed; injection of 1 ml. at points 12 ins. apart is equivalent to a rate of 10 U.S. gals. per acre. Treatment of the soil beneath chestnut trees with 25 lb. D-D or 10 U.S. gals. 41 per cent. ethylene dibromide per acre in this way or with 12·5–100 lb. parathion per acre, spread on the surface and disked in to a depth of five inches, caused no damage to the trees.

GAINES (R. C.). **Relation between Winter Temperatures, Boll Weevil Survival, Summer Rainfall, and Cotton Yields.**—*J. econ. Ent.* **46** no. 4 pp. 685–688, 4 refs. Menasha, Wis., 1953.

The results are given of further correlation studies based on yearly records from 1915 to 1952 of weather conditions, survival of *Anthonomus grandis* Boh. and yields of cotton in a district of Louisiana [*cf. R.A.E.*, A **31** 399]. It was found that the number of days in September–March on which

the temperature fell below 32°F. was inversely correlated with the number of living weevils found in Spanish moss [*Tillandsia usneoides*] during spring, the percentage surviving in hibernation cages and the number found in cotton fields during May and June, and the number on which it fell below 20°F. with the last two. The minimum temperature recorded during the winter was correlated with the percentage surviving in hibernation cages. The number of weevils found in ground or wood trash in February and March and the percentages surviving in ground trash and in hibernation cages were directly correlated with the number found in cotton fields in May and June and all these with the percentage increase in yield where the weevil had been controlled with insecticides. The total rainfall from 21st June to 19th August and the number of days on which 0·3 inch or more of rain fell were directly correlated with total yield and percentage increase in yield in treated plots and the percentage increase inversely with yield per acre and total yield.

For the years 1936–52, for which full records were available, the multiple correlation coefficients were 0·83 for the number of weevils found in ground trash in February and March, the number of days with 0·3 inch or more of rain from 21st June to 19th August and the percentage increase in yield in treated plots, 0·78 for the number of weevils found in cotton fields in May and June, the number of days with 0·3 inch or more rain and the percentage increase in yield in treated plots, and 0·69 for the percentage surviving in hibernation cages, the number of days with 0·3 inch or more of rain and the percentage increase in yield.

MacCarthy (H. R.). **Further Evidence of Tuber Damage by the Western Potato Flea Beetle.**—*J. econ. Ent.* **46** no. 4 pp. 688–689, 5 refs. Menasha, Wis., 1953.

Populations of *Epitrix subcrinita* (Lec.) increased considerably on potato in part of British Columbia in 1950–52. Weekly counts of adults in three untreated fields showed two peaks, corresponding to the emergence of the two summer generations, and a gradual increase in numbers as the season progressed and from 1951 to 1952; the leaves were skeletonised by the adults within a few days of the emergence of the second summer generation in August 1952. This flea-beetle has been thought not to injure the tubers [*cf. R.A.E.*, A **35** 43, etc.], but tunnels made by the larvae in them were observed in both years. Examination of 150 tubers selected at random in September 1952 showed that 97 had up to nine feeding marks per tuber, 38 had 10–19, and 15 at least 20. The presence of more than nine marks per tuber is considered to be of economic importance.

Brindley (T. A.) & Schopp (R.). **Tests with Aerosols for Control of the Pea Aphid.**—*J. econ. Ent.* **46** no. 4 pp. 689–690, 1 fig., 4 refs. Menasha, Wis., 1953.

Preliminary tests in 1947 having indicated that aerosols might give good control of *Macrosiphum pisum* (Harris) (*pisi* (Kalt.)) in the Pacific Northwest of the United States, four aerosols and two dusts were applied to peas against that Aphid in Oregon in June and in Idaho in July 1948.

Aerosol mixtures containing 5 per cent. DDT (aerosol grade) and 10 per cent. methylated naphthalene in methyl chloride and 10 per cent. of a 40 per cent. solution of TEPP (tetraethyl pyrophosphate) in methyl chloride were released at about 40 lb. per acre by means of 18 oil-burner nozzles with a capacity of 2 U.S. gals. per hour, projecting downward and

backward at an angle of about 45° in a single row along the 25 ft. boom of a power duster, and gave 97–98 and 90–97 per cent. reduction in population in five days, respectively. Mixtures containing 10 per cent. of the 40 per cent. TEPP solution and 10 per cent. acetone in Freon-12 [dichlorodifluoromethane] and 10 per cent. methyl isobutyl ketone and 10 per cent. acetone in Freon-12 were applied at about 10 lb. per acre, mixed with 20 lb. 5 per cent. DDT dust; the aerosol was released into the air inlet of the dusting machine with an oil-burner nozzle capable of delivering 9 U.S. gals. per hour, Freon-12 being substituted for methyl chloride to eliminate the danger of fire from the static charges in the fan housing of the duster. These treatments gave 91–96 and 76–94 per cent. reduction, respectively, and dusts of 1 per cent. TEPP or 5 per cent. DDT applied alone at about 20 lb. per acre 99 and 92–97 per cent. Methyl isobutyl ketone was tested in the hope that it would cause the Aphids to leave the inaccessible parts of the foliage and be more readily killed by the DDT, but the results showed that neither this material nor TEPP in aerosols improved the control given by DDT dust. The differences in control between DDT dust, DDT aerosol and TEPP aerosol applied alone were not significant. All aerosol treatments caused some plant damage, TEPP being most and methyl isobutyl ketone least injurious; the peas treated with aerosols appeared to mature faster than the others.

Stearns (L. A.). **The Biology and Control of the Nantucket Pine Moth and the European Pine Shoot Moth.**—*J. econ. Ent.* **46** no. 4 pp. 690–692, 1 graph, 5 refs. Menasha, Wis., 1953.

In Delaware, loblolly pine (*Pinus taeda*) has been seriously infested by *Rhyacionia frustrana* (Comst.) for many years and red pine (*P. resinosa*) has been increasingly attacked by this species and even more severely by *R. buoliana* (Schiff.) since about 1938. Investigations were carried out in 1948–50 to determine the exact importance of these moths, to evaluate insecticides for their control and to develop suitable treatments against mixed populations on red pine. In this area, *R. frustrana* has two generations a year and overwinters in the pupal stage, whereas *R. buoliana* has only one and overwinters as a partly grown larva. Observations on *R. frustrana* in 1950 showed that adult emergence began between 28th March and 5th April, reached 50 per cent. by 12th May and finished by 6th June for the overwintered generation and began between 7th and 11th July, reached 50 per cent. by 21st July and finished by 10th August for the summer one, and observations on *R. buoliana* in 1948–50 showed that emergence began on 11th–14th June, reached 50 per cent. by 19th–26th June and finished by 8th–11th July. It is therefore evident that control may be necessary on red pine from about 25th March to 10th August. The eggs of both species are laid near the tips of the twigs, on the needles, buds or shoots, and the larvae bore into the bases of the needles and into the buds and shoots, but whereas infested terminals usually contain only one example of *R. buoliana*, they may contain up to seven of *R. frustrana*. No parasites of the larvae were observed.

Red pines 4–8 ft. high and moderately and uniformly infested by *R. buoliana* were sprayed on 11th and 22nd June and 8th July 1948 with 16 fl. oz. nicotine sulphate and 4 fl. oz. of a proprietary spreader-sticker (as recommended in New Jersey [*cf. R.A.E.*, A **19** 349]), 1 U.S. gal. Volck summer oil and 1·5 lb. lead arsenate (as recommended in Connecticut [*cf.* **21** 234]), 1·5 lb. BHC (6 per cent. γ isomer), 10 oz. 25 per cent. wettable parathion or 1 lb. 50 per cent. wettable DDT per 50 U.S. gals., all of

which gave effective control. The trees also supported a much smaller population of *R. frustrana*, and this was not reduced by any treatment but DDT or parathion. The lead-arsenate spray caused heavy leaf-drop, from which the trees recovered gradually during the next season.

Infestation by both species is heaviest on young pines; as the trees approach maturity, damage decreases proportionately, but eradication becomes impossible, spraying ineffective and the cost of control prohibitive, and it is therefore considered advisable to confine operations to young plantings. Twigs infested by *R. buoliana* are easily seen and should be removed, preferably about 25th May, but those infested by *R. frustrana* are less easily detected and need to be removed by about 20th April, which is too early for control of *R. buoliana*. The practice is useful, however, and should be adopted in conjunction with sprays of 1 lb. DDT per 100 U.S. gals. water, applied by ground equipment nine times during the season, once at the 50 per cent. emergence date for each generation of the two insects and 14 days before and after each of these dates. DDT is preferred to parathion because of its greater persistence.

Young (M. T.) & Gaines (R. C.). **Control of Insects and Spider Mites on Cotton in 1952.**—*J. econ. Ent.* **46** no. 4 pp. 693–696. Menasha, Wis., 1953.

Calcium arsenate and various organic insecticides were tested against *Anthonomus grandis* Boh., *Heliothis armigera* (Hb.), the larvae of other Lepidoptera, *Aphis gossypii* Glov. and *Tetranychus bimaculatus* Harvey on cotton in Louisiana in 1952. Dusts were applied at about 10–12 lb. per acre with single-nozzle hand rotary dusters early in the morning, and sprays to three rows at a time with a three-nozzle sprayer when the plants were dry, the spray quantities given below being those of technical insecticide per acre.

In the first test, dusts were applied eight times between 21st July and 22nd August. Mixtures of BHC (to give 3 per cent. γ isomer), 5 per cent. DDT and 40 per cent. sulphur, in all applications or alternated with calcium arsenate, of 20 per cent. toxaphene with 40 per cent. sulphur, and of 5 per cent. DDT and 40 per cent. sulphur with 2·5 per cent. aldrin or heptachlor, 1·5 per cent. dieldrin or 15 per cent. toxaphene all gave satisfactory control of *Anthonomus*, whereas 2 per cent. methyl-parathion with 5 per cent. DDT did not. *Tetranychus* was of little importance throughout the season, Aphid infestation was light but heaviest in plots receiving DDT and BHC alternated with calcium arsenate, or DDT with heptachlor or aldrin, and infestation by *Heliothis*, which was also light, was controlled by all treatments. There were no significant increases in yield.

In the second test, nine applications were made between 18th July and 25th August. The dust mixture of BHC, DDT and sulphur alternated with calcium arsenate resulted in an increase in the Aphid, and a dust of 20 per cent. toxaphene and a spray of heptachlor and DDT (1 : 2) at 0·75 lb. in no control of it, a spray of toxaphene and DDT (2 : 1) at 3·98 lb. was effective against the mite, and all these and sprays of toxaphene at 2·78 lb., DDT and γ BHC (1 : 0·6) at 0·88 lb., DDT and γ BHC (1·5 : 0·9) at 0·85 lb., DDT and aldrin (1 : 1) at 0·81 lb. and DDT and dieldrin (2 : 1·5) at 0·75 lb. gave satisfactory control of *Anthonomus* and *Heliothis*. A spray of Systox [O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate (demeton)] at 0·5 lb., applied on 25th August, gave almost perfect control of the Aphid and mite. The yield was largest after dusting with the mixture of DDT and BHC alternated with calcium arsenate, and smaller following sprays of

toxaphene, alone or with DDT, which scorched the plants, than after other treatments.

In the third test, eight applications were made between 18th July and 20th August. Sprays of EPN [ethyl p-nitrophenyl thionobenzenephosphonate] and DDT (2 : 1) at 1·18 lb. or Metacide [containing methyl-parathion and a smaller proportion of parathion] at 0·67 lb. gave the best control of the mite, and sprays of endrin [*cf. R.A.E.*, A **41** 268, note] and aldrin (1 : 1·25), at 0·223 lb. and endrin and dieldrin (1 : 1) at 0·2 lb. the least. All these, a spray of endrin alone at 1·6 lb. and dusts of DDT, BHC and sulphur alternated with calcium arsenate or of 20 per cent. toxaphene with 40 per cent. sulphur gave satisfactory control of the Aphid, *Anthonomus* and *Heliothis*. Yields were greatest on plots treated with Metacide spray or the DDT and BHC dust mixture, but no differences were significant.

In the fourth test, alternate applications of the mixture of DDT, BHC and sulphur and of calcium arsenate at 4–5 day intervals between 21st July and 22nd August were compared with a dust of 2·5 per cent. aldrin and 5 per cent. DDT, which was applied to a series of plots on the same dates to increase populations of the mite and was followed on 22nd August by a spray of parathion at 0·25 lb. R-242 [p-chlorophenyl phenyl sulphone] at 0·98 lb., Metacide at 0·76 lb., Systox at 0·59 lb., Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] at 0·68 lb. or TEPP [tetraethyl pyrophosphate] at 0·28 lb. to control it. Both dust treatments gave satisfactory control of *Anthonomus* and *Heliothis*. All the acaricides had reduced mite populations to below the level for no treatment by 27th August, the reduction being greatest for Systox, and this was the only material that prevented a subsequent rapid increase. The yield was greatest on plots dusted with the mixture of aldrin and DDT and then sprayed with Systox.

In the last test, dusts were applied on the same dates as in the third. The mixture of DDT, BHC and sulphur in every application or alternated with calcium arsenate, one of 16 per cent. γ BHC with 10 per cent. DDT (at only 5 lb. per acre), 2 per cent. Metacide alone and a mixture of 3 per cent. γ BHC and 5 per cent. DDT, alone or with special oil, with 2 or 4 per cent Aramite, with 1 per cent. parathion or with 1 per cent. Metacide, significantly reduced infestation by *Anthonomus* and *Heliothis*. The only treatment resulting in higher Aphid infestations than occurred on the controls was the mixture of DDT with BHC alternated with calcium arsenate. Metacide, which gave good control of the Aphid, and the mixtures of DDT and BHC alone or with special oil failed to control the mite. All treatments caused significant increases in yield with no significant differences between them.

Davis (J. M.) & Elliott (K. R.). **A rapid Method for estimating Aerial Spray Deposits.**—*J. econ. Ent.* **46** no. 4 pp. 696–698, 2 figs., 1 ref. Menasha, Wis., 1953.

The authors describe the preparation and use of dyed paper to indicate the degree of atomisation of the droplets and the deposit from oil-based sprays applied from aeroplanes. An oil-soluble red dye is dissolved in acetone, applied to glazed white paper by brushing or immersion and allowed to dry, and the treated paper is sensitive to almost any oil-base solution. When a spray droplet strikes the paper, it appears to dissolve the dye and carry most of it to its perimeter; this results in a circular pinkish spot outlined by a dark ring of dye. Over a considerable range of droplet sizes, the ratio of the diameter of the ring to that of the droplet producing

it is fairly constant, ranging from 6 : 1 to 7 : 1 according to the characteristics of the spray used. Because this ratio is large, small droplets are readily visible, and because of its constancy, the method can be used for the rough determination of droplet sizes. The deposits can be evaluated visually to an accuracy of about 5 per cent. by comparing them with previously prepared papers bearing known deposits. The papers can be left exposed in the field for several days, are not affected by rain or dew and may be retained as a permanent record. In addition to indicating adequacy of coverage, they can be used in determining the relation between dosage and mortality.

The chief advantages of the method are the ease of handling and the rapidity of evaluation. It has proved useful in studying the deposits obtained in forest spraying in Canada and the United States and may be adapted for use in accurate experimental spraying.

Johnston (B. L.) & Eden (W. G.). **The Toxicity of Aldrin, Dieldrin, and Toxaphene to Rabbits by Skin Absorption.**—*J. econ. Ent.* **46** no. 4 pp. 702–703, 9 refs. Menasha, Wis., 1953.

Aldrin, dieldrin and toxaphene are widely used for the control of insects on cotton in Alabama, and there has been considerable inquiry as to which is the safest to handle. The toxicity of these materials when absorbed through the skin was therefore investigated. Rabbits were weighed and immersed up to the neck in specific volumes of wettable-powder suspensions of various concentrations for two minutes, while the mixture was agitated and rubbed into the fur, and were then removed and put in stocks for two hours to dry, after which they were covered to the neck in cloth bags and observed in individual cages for three days. The amount of insecticide deposited on each animal was calculated from the loss of volume of the suspension in which it was dipped. The median lethal dosages of aldrin, dieldrin and toxaphene were found to be between 15 and 25 mg., between 400 and 450 mg. and between 1,025 and 1,075 mg. per kg. body weight, respectively. Symptoms of poisoning for all three materials were loss of appetite, extreme nervousness, convulsions and muscular spasms. The findings on autopsy are described.

Benjamin (D. M.) & Underwood (N. B.). **Swaine Jack-pine Sawfly in Wisconsin.**—*J. econ. Ent.* **46** no. 4 p. 703, 1 ref. Menasha, Wis., 1953.

Adults reared from cocoons collected beneath defoliated jack pine [*Pinus banksiana*] near Lone Rock, Wisconsin, in March 1952 were identified as *Neodiprion swainei* (Midd.). This is the first record of this sawfly in Wisconsin and indicates an extension of its range to the south; near that State, it had previously been recorded from south-eastern Manitoba and Ontario. Eggs were deposited at the base of half-grown needles in early June, larvae in the first and second instars were observed feeding gregariously on the old needles early in July, and larvae in the fourth and fifth instars were present during late July. The infestation was confined to about 400 acres of planted jack pine, and *N. leconteci* (Fitch) was also present on jack pine and red pine [*P. resinosa*] within the infested area. Applications of an oil spray containing 1 lb. technical DDT per U.S. gal. at the rate of 1 U.S. gal. per acre by aeroplane on 15th July, when most of the larvae were in the second instar, reduced the population by an average of 96 per cent. in 48 hours.

Martin (D. F.). **Peach Tree Borer Control.**—*J. econ. Ent.* **46** no. 4 pp. 704–705, 4 refs. Menasha, Wis., 1953.

Ethylene-dichloride emulsion and p-dichlorobenzene crystals are generally used for the control of *Aegeria (Sanninoidea) exitiosa* Say on peach in Texas, but safer and less expensive treatments are needed, and wettable-powder sprays applied to the trunks were therefore compared with these fumigants in 1951–52. The sprays were applied at the rate of 2–3 U.S. quarts per six-year-old tree on 17th July, 21st August and 22nd September 1951, on the first two dates or on the first only, and the fumigants on 17th November 1951. Counts of borers, not specifically identified, in June 1952 showed that three applications of 1 lb. 25 per cent. γ BHC as lindane, 8 lb. 50 per cent. DDT or 2 lb. 25 per cent. dieldrin per 100 U.S. gals. water gave 95 per cent. or more reduction in population, as compared with no treatment, and two of DDT or lindane 93 per cent., whereas three of 2·5 lb. 40 per cent. chlordane or 1 lb. 25 per cent. EPN [ethyl p-nitrophenyl thionobenzenephosphonate] gave less than 90 per cent. and one of EPN less than 50 per cent. Ethylene dichloride at 0·5 U.S. pint 25 per cent. emulsion and p-dichlorobenzene at 1 oz. per tree gave 97·5 and 95·5 per cent. reduction, respectively.

Atcheson (W. C.). **An ecological Study of three Species of Mites on American Linden.**—*J. econ. Ent.* **46** no. 4 p. 705, 5 refs. Menasha, Wis., 1953.

The foliage of American lime [*Tilia americana*] at College Park, Maryland, turned brown prematurely in July and August 1952, and the Aphid, *Myzocallis (Therioaphis) tiliae* (L.), and the mites, *Czenspinskia lordi* Nesbitt, *Septanychus (Tetranychus) canadensis* McG., and *Typhlodromus* sp., were found on the leaves. The Aphid excreted honeydew, on which a sooty mould developed, and *C. lordi* fed on this. *S. canadensis* caused severe thinning of the foliage at the top of the tree, and *Typhlodromus*, which is predacious, was probably feeding on the other two mites, though this was not observed and it did not control them.

Dominick (C. B.). **Control of Green June Beetle Larvae in Alfalfa Fields with Parathion.**—*J. econ. Ent.* **46** no. 4 pp. 705–706. Menasha, Wis., 1953.

Cotinis nitida (L.) has become an important pest in lucerne fields in parts of Virginia. The larvae of this Cetoniid feed largely on organic matter on or near the soil surface, pulverising the soil, and are most injurious in light sandy soils rich in organic matter. The extent of damage in established stands of lucerne, other than that due to the depletion of organic matter in the soil and possibly increased water loss, has not been determined, but a new stand on heavily infested soil is often greatly reduced or destroyed during spring and autumn, particularly in dry periods when the seedlings are small and making little growth.

In October 1952, a heavily infested established stand of lucerne that had recently been clipped was treated with a 0·75 per cent. parathion dust, diluted with an equal quantity of moist sand, or with 0·75 per cent. parathion on granulated tobacco, both being broadcast at 0·75 or 0·375 lb. actual toxicant per acre. Collections of dead and moribund larvae from the soil surface at intervals of 1–2 days for a week and of larvae induced to come to the surface by a drench of 8 oz. 15 per cent. wettable parathion

in 25 U.S. gals. water, applied at the rate of 1 U.S. gal. per square yard at the end of this time, showed that both formulations gave about 96 per cent. reduction in a week at the higher rate and about 88 per cent. at the lower one. Most larvae came to the surface during the first day after treatment at the higher rate and during the second after the lower one.

It is concluded that parathion at 0·375 lb. per acre gives adequate mortality if applied sufficiently early and under favourable conditions, and that this treatment will give rapid and effective control when it is found that lucerne has been sown or resown on infested soil.

Snapp (O. I.). **Effect on the Oriental Fruit Moth of Materials used for Plum Curculio Control.**—*J. econ. Ent.* **46** no. 4 p. 707. Menasha, Wis., 1953.

As some of the materials recently tested in field-plot experiments against *Conotrachelus nenuphar* (Hbst.) on peach in Georgia are toxic to *Cydia* (*Grapholitha*) *molesta* (Busck), harvested peaches from treated plots were examined for injury by the latter in 1951 and 1952. Parathion, which had also been the most effective material against the moth in 1949 and 1950, at 3 lb. 15 per cent. wettable powder and EPN [ethyl p-nitrophenyl thionobenzenephosphonate] at 1·5–2 lb. 25 per cent. wettable powder per 100 U.S. gals. gave the best control, 4–5 applications reducing the percentage of fruits infested to 1·5 in 1951 and to 4·1 and 5·2, respectively, in 1952; 3–4 applications of 2 lb. lead arsenate or 50 per cent. wettable p,p′methoxy-DDT (methoxychlor) per 100 U.S. gals. were less effective, and four of 2 lb. 25 per cent. wettable aldrin or dieldrin least so.

Huffaker (C. B.) & Kennett (C. E.). **Differential Tolerance to Parathion of two *Typhlodromus* predatory on Cyclamen Mite.**—*J. econ. Ent.* **46** no. 4 pp. 707–708, 1 ref. Menasha, Wis., 1953.

Studies on the natural control of the cyclamen mite [*Tarsonemus pallidus* Banks] on strawberry in California revealed the existence of two or more predacious mites of the genus *Typhlodromus* with marked differences in susceptibility to parathion dust, *T. occidentalis* Nesbitt persisting after repeated direct and very heavy treatments, and the others, which may be *T. reticulatus* Oudm., *T. cucumeris* Oudm. or a mixed population of these two species, being consistently destroyed by them and unable to survive on treated plants even after periods of 2–3 months. In laboratory tests, adults of these mites were separated and confined with strawberry leaves dusted with 2 per cent. parathion. The percentage mortality after 24 hours was 37 for *T. occidentalis* and 100 for the others.

Griswold (C. L.) & Neiswander (R. B.). **Insect Vectors of Oak Wilt Fungus.**—*J. econ. Ent.* **46** no. 4 p. 708. Menasha, Wis., 1953.

Attempts to discover the insect vectors of *Endoconidiophora fagacearum*, the fungus that causes oak wilt, were begun in Ohio in October 1951. Three species of *Pseudopityophthorus* were found breeding in large numbers on oaks that had been killed by the disease, and laboratory tests showed that they bred in recently cut or dying stems or branches 0·5–5 ins. in diameter. The adults of *P. minutissimus* (Zimm.) and *P. pruinosus* Eichh. occasionally left such material to feed in the small twigs of healthy trees and might therefore be responsible for transmitting the fungus. When small oak trees in eight-inch pots were caged with sections of diseased wood

containing many examples of these Scolytids, the latter soon moved to the small twigs of the healthy trees to feed. Several of the trees developed symptoms similar to those of the disease, but the fungus could not be isolated from them, and the feeding of the beetles may have caused mechanical injury sufficiently severe to induce the symptoms observed. However the fungus is known to die rather quickly when infected wood becomes dry, and it is therefore possible that the cultures were not attempted at the right time.

As numerous oaks in Pennsylvania that had been blazed to make a trail in April 1952 had died from oak wilt by September, it was thought that bleeding wounds might serve as points of ingress for the fungus. Unidentified species of *Drosophila* were abundant in woods in central Ohio where many oaks had died from the disease, and since *D. melanogaster* Mg. was found to be much attracted to sporulating mats of the fungus, this species was tested as a vector. Eggs were readily deposited in the fungus mats, and the progeny developed to the adult stage. The flies were also strongly attracted to bleeding wounds caused by *P. minutissimus* and *P. pruinosus* on the twigs of healthy oaks. Microscopic examination of *Drosophila* adults that had fed and oviposited on the sporulating fungus showed that endospores were present on the legs and throughout the intestinal tract and were numerous in regurgitation droplets and excreta, and when *Drosophila* adults that had been confined on sporulating material were permitted to walk over sterile agar for 1–2 minutes, colonies of the fungus developed on the agar, indicating that the adults may carry viable endospores. It remains to be discovered whether the fungus will grow in the bleeding wounds and penetrate the sapwood.

Menke (H. F.). **Pea Aphid Injury in Alfalfa Seed Fields.**—*J. econ. Ent.* **46** no. 4 p. 709, 1 ref. Menasha, Wis., 1953.

Macrosiphum pisum (Harris) (*pisi* (Kalt.)) had been only a minor pest of lucerne grown for seed in Washington until 1952, when it was numerous in many fields until mid-August, causing heavy fall of the florets and reducing seed production by about 50 per cent. in one instance cited. A dust containing 10 per cent. DDT and 1 per cent. parathion was applied at 25 lb. per acre in some fields for pre-bloom control of *Lygus* and *M. pisum*, but the Aphid became numerous again in 3–4 weeks, owing to migration from untreated fields, and parathion applied at that time, when the lucerne was in flower, caused severe poisoning of honey bees and *Nomia melanderi* Ckll.; a dust of 1 per cent. TEPP [tetraethyl pyrophosphate] at 30 lb. per acre had very little effect, whereas a spray of 1 U.S. quart 40 per cent. miscible TEPP in 5 U.S. gals. water per acre, applied on hot calm days at 6 p.m., so as not to injure bees, gave excellent control, though it caused some foliage injury; it was ineffective at half the rate.

It is concluded that 1 per cent. parathion should be added to the first application of DDT dust against *Lygus* if the Aphid is present and that 1 U.S. quart 40 per cent. TEPP in 5–8 U.S. gals. water per acre, applied after 6 p.m., will give control later in the season without danger to bees.

Simeone (J. B.). **The Effect of Cellulose Acetate Sheets on** *Lasioderma serricorne*.—*J. econ. Ent.* **46** no. 4 pp. 709–710, 2 refs. Menasha, Wis., 1953.

Cellulose acetate has recently been shown to be toxic to plants and fish when plasticised with diethyl phthalate, and experiments were therefore

carried out to determine whether it is also toxic to insects. Cages made partly from sheets of cellulose acetate plasticised with diethyl phthalate were used, and *Lasioderma serricorne* (F.) was reared from egg to adult in them. In a large cage, in which the ratio of plastic surface in square inches to cage volume in cubic inches was 1 : 4·7, there was no reduction in the proportion reared to the adult stage, as compared with controls, but in small ones, in which the ratios were 1 : 0·13 and 1 : 0·06, there was a highly significant reduction in the number of eggs hatching in the second case and highly significant reductions in the numbers of larvae completing the first instar in both; all insects that survived to the second instar completed their development.

Milum (V. G.). *Vitula edmandsii* **as a Pest of Honeybee Combs.**—*J. econ. Ent.* **46** no. 4 pp. 710–711. Menasha, Wis., 1953.

Larvae of *Vitula edmandsii* (Pack.), which is known as a scavenger in the nests of bumble bees in Illinois, were found infesting combs of honey bees in Nebraska and Wyoming [*cf. R.A.E.*, A **28** 615, etc.]. Those from Wyoming had survived a cold winter in an unheated room and it was reported that although most of the larvae of this Pyralid are killed during cold weather, some adults always appear in the autumn and considerable damage is caused to combs containing pollen. Rearing experiments showed a great variation in the length of the life-cycle, depending on a variable period of diapause in the larval stage, and indicated that under natural conditions the larvae pass the winter in diapause.

Ristich (S. S.) & Lockard (D.). **An Aspirator modified for sampling large Populations.**—*J. econ. Ent.* **46** no. 4 pp. 711–712, 1 fig., 3 refs. Menasha, Wis., 1953.

The aspirator for sampling large insect populations recently described [*R.A.E.*, A **41** 90] has been further improved by the use of tapered adaptors that make it possible to collect the insects in containers of any size and eliminate the necessity for screwing on each vial.

Finney (G. L.). **A Technique for Mass-culture of the Six-spotted Mite.**—*J. econ. Ent.* **46** no. 4 pp. 712–713. Menasha, Wis., 1953.

This is the complete text of a paper on a laboratory method of rearing *Tetranychus sexmaculatus* Ril. in large numbers, part of which was accidentally omitted from the version already noticed [*R.A.E.*, A **41** 372].

The difficulty of applying sufficient lint to the oranges without masking the feeding area from the mites [*cf. loc. cit.*] was overcome by replacing paper lint with kapok lint, which is resilient and can be used in a heavier layer. The linted fruits are infested by contact with infested fruits, the rate of transfer of the mites depending on the population and the degree of exhaustion of the feeding area on the infested oranges. Heavy uniform populations of *T. sexmaculatus* were obtained when kapok lint was used.

Rodriguez (J. G.). **Detached Leaf Culture in Mite Nutrition Studies.**—*J. econ. Ent.* **46** no. 4 p. 713, 2 refs. Menasha, Wis., 1953.

The author describes a modification of a method of investigating the mineral nutrition of the two-spotted spider mite [*Tetranychus bimaculatus* Harvey] in the laboratory [*cf. R.A.E.*, A **40** 386] for use when the mites

are to be reared on leaves of apple, bean or rose. Leaves from plants grown in the greenhouse are detached, and disks from them are washed, treated with tanglefoot at the cut edge and floated in sucrose solution or water in petri dishes, after which they are infested with young female mites. Tap water kept the disks of rose, apple and tomato foliage in good condition for three weeks, but those from bean leaves developed roots, which caused water to creep over the surface of the disk. A 2 per cent. sucrose solution inhibited rooting for about two weeks. Rearing was carried out with a light intensity of 300 foot-candles and a photo period of 16 hours a day at a temperature at 25–27°C. [77–80·6°F.], and the dishes containing the disks were refrigerated to inactivate the mites before counting.

Brett (C. H.). **Fall Armyworm Control on late planted Sweet Corn.**—*J. econ. Ent.* **46** no. 4 pp. 714–715, 2 figs. Menasha, Wis., 1953.

Laphygma frugiperda (S. & A.) is one of the most destructive pests of late sweet maize in North Carolina. In 1952, moths were ovipositing on 19th August on maize 2–4 ins. high, and larvae were present in considerable numbers by 26th August. Untreated plants were so heavily attacked that they did not exceed 10–12 ins. in height and were dying after a month and dead by 17th October.

Emulsion sprays of technical DDT and methoxy-DDT (methoxychlor) at 1 lb. per acre and isodrin and endrin [*cf. R.A.E.*, A **41** 268, note] at 0·25–0·5 and 0·12–0·25 lb. per acre, respectively, were applied on 26th August, 3rd, 9th, 16th and 30th September and 7th October. All the sprays were highly toxic to the larvae. On 3rd and 9th September, there was least injury due to *Laphygma* on plants treated with endrin at 0·25 lb., but the plants that were the most effectively protected became more attractive to the insects, and subsequent attack was so heavy that counts of the larvae showed merely that the largest and most succulent plants were the most heavily invaded; there seemed to be little control from residues. All the sprays had some phytotoxic effect, but differences in weight, height and silking showed that those containing endrin were the least and those containing DDT and methoxy-DDT the most injurious; the amount of injury was roughly in inverse proportion to the amount of spray material used per acre. The final results indicated that endrin at 0·12 lb. per acre controlled *L. frugiperda* sufficiently to permit good plant growth with little insect damage or phytotoxic effect.

Greenhouse tests in which maize plants were sprayed at the same stages of development as in the field with the emulsifiers and solvents alone and with emulsifier, solvent and insecticide (except methoxy-DDT) showed the same effects of scorching and retarded development. This was roughly in inverse proportion to the amount of emulsifier and solvent present, xylene, one of the principal solvents, being apparently of importance in producing the injury. None of the insecticides caused any increase in phytotoxicity when included in the sprays.

Puttarudriah (M.). **The natural Control of the Alfalfa Looper in central California.**—*J. econ. Ent.* **46** no. 4 p. 723. Menasha, Wis., 1953.

Plusia (*Autographa*) *californica* Speyer is common on lucerne in California, but does not cause economic damage, probably owing to control by natural enemies. The importance of these was studied in 1948. Larvae were collected in March–May, and about 24 per cent. of them were parasitised by the Tachinid, *Voria ruralis* (Fall.), and about 9 per cent. by the

Braconids, *Microplitis* sp., *M. alaskensis* Ashm. and *Apanteles yakutatensis* Ashm. (*hyslopi* Vier.), and the Ichneumonids, *Campoletis* (*Sagaritis*) *websteri* (Vier.) and *Patroclus montanus* (Cress.). Parasitism was heavier in May than earlier. All but *V. ruralis* and *A. yakutatensis* usually developed singly in the host. The eggs of *P. montanus* were deposited in fairly large larvae, and the adult parasites emerged from the host pupae. The other parasites attacked the larvae in all but the very early instars. Bacterial and fungus diseases killed about 41 per cent. of the larvae in the field, and combined attack by parasites and diseases gave about 70–80 per cent. mortality, which kept the pest below the economic level.

Gressitt (J. L.). **The Coconut Rhinoceros Beetle** (*Oryctes rhinoceros*) **with particular Reference to the Palau Islands.**—*Bull. Bishop Mus.* no. 212, viii + 157 pp., 50 figs., 310 refs. Honolulu, 1953.

Oryctes rhinoceros (L.) was introduced into the Palau group of the western Caroline Islands about 1942 [*cf. R.A.E.*, A **40** 96], and the abundance of war-killed palms enabled it to spread and kill one half of the coconut palms on the entire group in ten years. Field and laboratory investigations on its bionomics, ecology and control were carried out in 1951–52 and supplemented by briefer studies in Western and American Samoa in January 1952. This bulletin contains a detailed account of the work, descriptions of the characteristics of the Palau Islands, the spread of the beetle in them, its morphology, anatomy and ecological relations, including such aspects as food-plants and breeding sites, the extent of damage and population trends on five of the islands, invertebrates and vertebrates associated with it, and the ecological succession observed in coconut palms following attack by larvae and adults, and a review of the distribution of the beetle and the control measures used against it in various parts of the world. *O. rhinoceros* occurs from southern Asia to the southern Pacific, and it is stated that records of it from Africa [*cf.* **11** 21; **16** 429] and Mauritius [and also apparently from the Seychelles (**6** 375; **7** 483; **9** 275; **14** 523)] are based on misidentifications and further pointed out that a record from Zanzibar [**8** 118] is due to an error in this *Review*. Short accounts are also given of the climate and geology of Samoa, and of the extent of damage to coconut by *O. rhinoceros*, the control measures adopted, and its natural enemies and alternative food-plants there.

In the Palau Islands, the eggs hatched in about 12 days, the larval stage lasted from 80 to over 130 days in reared examples, but appeared to average about 72 days (including a prepupal resting stage of about a week) among marked groups of larvae kept outdoors, and the pupal stage lasted 16–24 days (generally 18–21). The adult males and females survived for about 90 and 100 days, of which 17–22 were spent in the pupal cell. Development appeared to be even and continuous, and more than three generations may develop each year under favourable conditions. The two sexes were about equal in numbers, and the females laid about 90 eggs each. Mature coconut palms are preferred by the adults, though young palms are also attacked, but *Pandanus tectorius* is preferred to very young palms and provides a source of infestation where mature coconut has been exterminated; it is here recorded as a food-plant of *O. rhinoceros* for the first time. Other food-plants include most other kinds of palms, sugar-cane, pineapple, *Agave*, banana and probably taro (*Colocasia*) and some large succulent plants. The standing trunks of dead coconut palms form the principal breeding sites, but almost any kind of dead wood can be used provided that it is fairly large, old enough to have rotted to a rather soft state,

and neither too dry nor too wet, as well as various decaying vegetable materials, soil containing humus, living roots and unhealthy living plant stems.

Control of *O. rhinoceros* by insecticides is impracticable, and the chief measure adopted in the Palaus was the removal of dead palms and other trees, which are usually placed in the sea or in streams or marshes so that they become unsuitable for breeding, but are sometimes cut up and buried. As a result, beetle populations are diminishing, and it is hoped that copra production may be resumed. Where breeding sites have been largely eliminated, the use of compost pits or split sections of coconut logs as traps is recommended, provided that they are inspected regularly and the larvae and adults removed. In palm groves adjoining jungle, where breeding cannot be prevented, especially if it contains *Pandanus* or palms, biological control is recommended. Although small numbers of *Scolia ruficornis* F. were introduced from East Africa during 1947–48 and from Zanzibar in 1950–51 and of *S. patricialis* var. *plebeja* Grib. [*cf.* **40** 96] and *S. procer* Ill. from Malaya and released in Palau, no living Scoliids were recovered in December 1952, but one had been observed in the previous September. In 1952, a consignment of the Histerid predator, *Pachylister chinensis* (Quens.) was received from Western Samoa, where it had been established for the control of larvae of *Musca domestica* L. and appeared to be feeding on young larvae of *O. rhinoceros*; in laboratory tests, both larvae and adults fed on first-instar larvae of the beetle, and releases were made on Koror. *Placodes ebeninus* Lewis, another Histerid that attacked the larvae under experimental conditions, was introduced from Tanganyika.

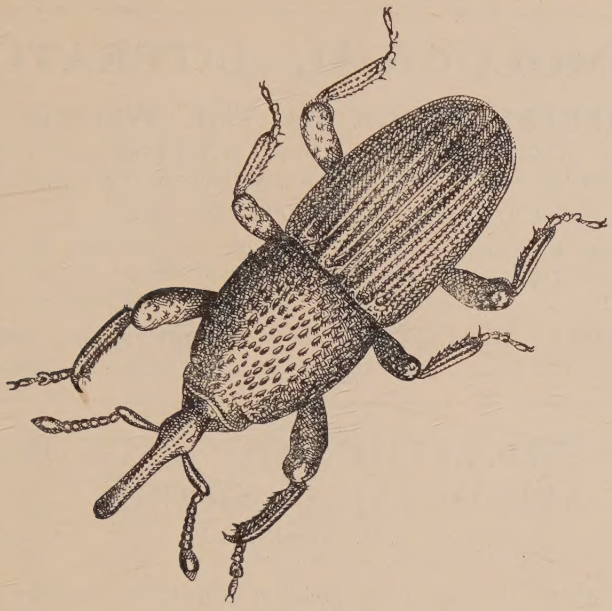
In Western Samoa, where *O. rhinoceros* has been established for over 40 years, it has caused great damage, but has killed less than 15 per cent. of the coconut palms, and, with the assistance of native predators and introduced natural enemies, including *S. ruficornis* [*cf.* **38** 48] and *Pachylister chinensis*, and more efficient elimination of breeding sites, damage will probably be reduced to a low level. The beetle was eradicated from one island, six miles square, by the elimination of breeding sites and the use of coconut-log traps inspected twice weekly, but on the larger islands, where it can breed in the jungle, eradication would be very difficult. Damage in American Samoa is much less severe.

Rigid quarantine measures are necessary to prevent further spread in the Pacific islands, and the elimination of palms and breeding sites near docks or anchorages at infested ports, the examination of ships, aircraft and baggage at ports, and the entry of ships from infested areas into uninfested ports in the morning, to prevent any beetles on them from flying ashore, are considered desirable.

PAPERS NOTICED BY TITLE ONLY.

TRINIDAD & TOBAGO. **Regulations concerning the Importation of Plants and Plant Products, etc.**—*Bull. Dep. Agric. Trin. Tob.* (N.S.) no. 5, 24 pp. [Port-of-Spain, 1953.]

DENMARK. **Orders issued by the Royal Danish Ministry of Agriculture concerning the Exportation and Importation of Plants and Parts of Plants.** [*In French & English.*]—53 pp. Copenhagen, 1953.



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